VILLAGE-SCALE PRACTICES AND WATER SOURCES IN INDIGENOUS MEXICO AFTER THE NEOLIBERALIZING OF SOCIAL PROPERTY

by

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Abstract

To establish whether social property villages ("*núcleos agrarios*") in indigenous, well-watered parts of Mexico are maintaining the same degree of village-scale control of water sources that they practiced before the neoliberal land tenure reforms of the 1990s, three sources of data were investigated in two regions: the Huasteca of San Luis Potosí state (home to indigenous Teenek, Nahua, and Pame residents, as well as non-indigenous people), and the Sierra Norte of Oaxaca state (home to indigenous Zapotec and Chinantec residents, and a smaller number of non-indigenous people). The three data sources were: 1. Archival documents at state offices of the National Agrarian Registry (*Registro Agrario Nacional*, or RAN); 2. Participatory research mapping (PRM) data acquired in fifteen villages, with the author as sole academic researcher in one of these (the Zapotec *núcleo* of Talea de Castro); 3. GIS (geodata) analysis of water sources (springs) and land tenure zones in both regions, encompassing about 460 social property *núcleos* as well as private and public lands.

Neither spatially-defined ownership of land where water resources are located, nor conceptual rights and obligations (enacted through local practices), were found to have undergone extraordinary changes in the two decades since the neoliberal reforms were initiated. However, these reforms were found to have played a key role in the gradual shift in legal and practical emphasis away from a fusion of village and individual attachments to water sources (regardless of legal or locally-defined land tenure), and toward a simplified, spatially unambiguous distinction between village and individual land units, linked to a nationwide program of water rights concessions which favor the individual and the state over the village. This shift in emphasis is being successfully resisted in many villages, particularly in indigenous ones. This resistance often takes the form of creative engagement with state initiatives such as the 1993-2006 land surveying and certification program PROCEDE and its successor FANAR. Nevertheless, village orientation toward water partly depends on de facto, orally transmitted local practices which will vanish in some villages during the next several decades.

Resumen

Para establecer si los pueblos de propiedad social ("*núcleos agrarios*") en las regiones indígenas con agua abundante mantienen el mismo nivel de control de parte de los pueblos sobre los recursos acuáticos que practicaban antes de las reformas neoliberales de tenencia de tierra en los años 90, se investigó con tres fuentes de datos en dos zonas: la región Huasteca del estado de San Luis Potosí (donde viven los indígenas teenek, nahua, y pame, y también gente mestiza), y parte de la Sierra Norte de Oaxaca (donde viven los indígenas zapoteco y chinanteco, además gente mestiza). Las fuentes de datos eran: 1. Documentos históricos en las oficinas estatales del Registro *Agrario* Nacional (RAN); 2. Datos obtenidos a través de la investigación cartográfica participativa (ICP) en quince pueblos, con el autor como el único investigador académico en uno de ellos (el núcleo zapoteco Talea de Castro); 3. Análisis SIG (geodatos) de las fuentes acuáticas (manantiales) y las zonas de tenencia de tierra en ambas áreas de estudio, incluyendo aproximadamente 460 *núcleos* de propiedad social tanto como tierras privadas y públicas.

Se determinó que ni el dueñazgo de tierra donde se encuentran los recursos acuáticos en términos espaciales, ni los derechos y las obligaciones (realizados a través de las prácticas locales), han cambiado en el extremo en las últimas dos décadas desde el comienzo de las reformas neoliberales. Lo que sí ha cambiado es el movimiento gradual en el énfasis legal y práctico desde una fusión de vínculos entre el pueblo, los individuos, y las fuentes acuáticas (independiente de la tenencia de legal o práctico de tierra), hacía una distinción simplificada y espacialmente inequívoca entre las unidades terrestres del pueblo y de los individuos, ligada a un programa nacional de concesiones de derechos hídricos que favorecen el individuo y el estado sobre el pueblo. Muchos pueblos rurales están resistiendo exitosamente este cambio de énfasis, especialmente en las zonas indígenas. En varios casos la resistencia corresponde a métodos creativos de entablar con las iniciativas gubernamentales como el PROCEDE (un programa de levantamiento y certificación de tierras entre 1993 y 2006) y su programa sucesor FANAR. No obstante, la posición comunal hacía el agua parcialmente depende de las prácticas de hecho, oralmente transmitidas, las cuales desvanecerán en algunos pueblos en las próximas décadas.

Preface

My curiosity about indigenous Mexico began in 1992, when I mapped the forest, village, and golf course around the Maya archaeological site of Dzibilchaltún, Yucatán in a naïve but enthustiastic effort to document changes in the cultural landscape over the past two millennia. For much of the time between 1996 and 2004, I was fortunate to enjoy many opportunities to collaborate with local rural residents and experts in many fields related to conservation and development, often in and around the Calakmul Biosphere Reserve of Mexico's Campeche state. One task assigned to me was to assist the *ejidatarios* of El Refugio in the surveying and demarcation of their de facto individual parcels and community forest reserve; I was only dimly aware at the time that PROCEDE had just months before surveyed their *núcleo* perimeter.

From 2005 to 2008, I was honored to be a member of the multinational México Indígena research team, the proptotype for the American Geographical Society Bowman Expeditions. During the final months of the project, I traveled to the Rincón Bajo region of Oaxaca with Ángel Santos Santiago, and there began to consider the possible links between land and water in the evolving practices within indigenous villages.

Well before I discovered that it had been the longtime research focus of Ralph Nader's sister Laura, I was intrigued by the Zapotec village of Talea de Castro: an upland, water-rich, proudly indigenous *comunidad* which, unlike most of its Sierra Norte neighbors, had undergone PROCEDE surveying of individual parcels. Did Talea offer a glimpse of the future in rural indigenous Mexico? Luckily, the authorities and residents of the village were kind enough to let me try and find out.

During research for this study, I was guided by many scholars, through their published works and conference presentations. Here I will just mention one work: Wageningen University (Netherlands) sociologist Monique Nuijten and Roskilde University (Denmark) then-doctoral student David Lorenzo's chapter on Andean local property practices, published in Sikor and Lund's 2009 edited volume *The Politics of Possession: Property, Authority, and Access to Natural Resources.* I was inspired by their articulation of the concept of a "practice force field approach" in contrast to a "system of property rules," of property as "not a relationship between people and things but between people *about* things." Drawing from Pierre Bordieu and Loïc

Wacquant's (1992) approach of seeing "the field as the locus of relations of force and not of rule," Nuijten and Lorenzo "give a central place, however, to 'rule talk', the ways in which people claim rights to land, frame their explanations of property relations in normative terms, and express themselves about categories of villagers with different privileges and obligations" (Nuijten and Lorenzo 2009, 79-80).

In text passages with content derived from fieldwork in villages, human subjects who held public office during my visit (e.g., *presidente del comisariado ejidal* or *presidente de bienes comunales*), or who gave permission to be included in map legends for published community maps developed through participatory research mapping (PRM, a technique described on pages 73-74), are quoted or mentioned using their real names. Other village residents are given pseudonyms, and identified in the References section with a dagger symbol (†). After fieldwork had been completed and their PRM community maps delivered, two of the México Indígena PRM communities, Tiltepec and Yagila, requested that their maps be withdrawn from public access and that any personal data developed during their production be destroyed. The México Indígena team immediately complied with these requests. The water source and de facto land tenure information for these two *comunidades* that I draw from in this study was developed independently of the México Indígena community map work, and was collected with the permission of the individuals and communities involved.

All translations of Spanish texts are mine.

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For their guidance and assistance during my fieldwork, I thank Miguel Aguilar Robledo, coordinator of the Social Sciences and Humanities Program at the Universidad Autónoma de San Luis Potosí (UASLP); José Luis Cruz Piñeda, Oaxaca regional director of the CDI (Comisión Nacional para el Desarrollo de los Pueblos Indígenas); Ángel Santos Santiago, fieldwork coordinator with the México Indígena project in Oaxaca and a *comunero* of the *núcleo* of Ixtlán de Juárez; the people of the *núcleo* (village) of Talea de Castro, in particular their *presidente de comisariado de bienes comunales* Jaime Andrés Rodríguez; and all members of the México Indígena research team, particularly Aida Ramos Viera, Derek Smith, Andrew Hilburn, and project co-director Jerome Dobson.

For their having urged me at crucial moments to recover my destiny as a geographer, I thank Michael Conzen of the University of Chicago; Peter Gould (deceased) of Pennsylvania State University; my stepfather Warren Kinzey (deceased); my uncle Stephen Korns; and my friend Ramiro Aragón, a brilliant and passionate expert on the birds (and geography) of his beloved Oaxaca.

For their patience and confidence, I am deeply grateful to my wife Sangeetha, my son Luke, and my adviser Peter Herlihy.

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Glossary

CDI Mexico's federal commission for indigenous affairs.

civic parcel A parcel surveyed by PROCEDE in a *núcleo*'s area of individual parcels, but assigned to the *núcleo* itself. It is not an official term.

comisariado The "mayor" of a *núcleo agrario*. Technically, the term also includes the mayor's secretary and treasurer.

common use area Land determined by a *núcleo* assembly to be neither a human settlement nor an area of individual parcels, but which exists to benefit all *núcleo* members. In practice, often a rugged, wooded area with poor soils.

comunero/a Official member (usually, a descendant of an original head of household) of a *comunidad agraria*. The assembly of *comuneros* is the highest village-level authority.

comunidad Short for *comunidad agraria*. A *núcleo* formed when the federal government recognized its residents as having "presumably held possession of the lands, forests, and waters since time immemorial, with communal customs and practices."

CONAGUA Mexico's federal water commission.

consejo de vigilancia Three-member "security council" of a *núcleo agrario*, mainly responsible for ensuring the three-member *comisariado* fulfills its duties.

DAAC Predecessor of the SRA (federal agriculture ministry).

de facto "As practiced in real life." In this study, this usually refers to land tenure designations recognized within a village community, but not part of the state-sanctioned legal system. Von Benda-Beckmann, von Benda-Beckmann, and Wiber (2006, 13) call these expressions of "concretized property relations."

de jure "According to law." In this study, this usually refers to land tenure designations as recognized by the state, according to the most recent "agrarian action" (official ruling which follows a government land survey). Von Benda-Beckmann, von Benda-Beckmann, and Wiber (2006, 13) call these expressions of "categorical property relations."

dominio pleno Fully privatized title to a property, akin to "fee simple" in common law.

GAIA A public GIS web portal maintained by INEGI which has sometimes included spatial data layers depicting all *núcleos*, *grandes areas*, and parcels surveyed by PROCEDE until its closure in 2006, and some territories subsequently surveyed by FANAR.

gran area (pl. *grandes areas*) PROCEDE-surveyed land tenure zones within a *núcleo*. The potential categories are "human settlement area," "parceled area," and "common use area."

ejidatario/a Official member (usually, a descendant of an original head of household) of an *ejido*. The assembly of *ejidatarios* is the highest village-level authority.

ejido A *núcleo* formed when the federal government granted an eligible group of farmers a territory that, in most cases, had been formed by the government's having condemned one or more (or part of a) private property found to exceed the limits set by the land reform mechanisms established after the Mexican Revolution of 1910-1920.

FANAR Successor to PROCEDE, without that program's guarantee of no cost to the *núcleo* for its surveying and certifying services.

human settlement area A legal term for the part or parts of a *núcleo* where most or all of the permanent houses are clustered. A population center that has been surveyed by PROCEDE. Synonymous with "urban zone."

localidad 1. An INEGI rural census tract, geospatially regarded as a point. 2. In PROCEDE maps, a population center in a region dominated by social property which lacks official status as a *núcleo*.

INEGI Mexico's federal bureau of the census, of statistics, and of publicly available geographical and cartographical products.

manantial A common Spanish word for "spring," in the sense of "water source."

mestizo The common Mexican term for someone who is not regarded as indigenous, or does not regard themselves as such. In some countries the equivalent term is "*ladino*."

México Indígena A 2005-2008 research project which used participatory research mapping (PRM) and other methods to illuminate cultural geographic issues in indigenous Mexico. The team brought together professors, students, and local residents from Canada, the United States, and Mexico, with guidance mainly from scholars at the University of Kansas, the Universidad Autónoma de San Luis Potosí, and the Foreign Military Studies Office of Fort Leavenworth, Kansas.

municipio In Mexico, a county-level administrative unit.

núcleo Short for *núcleo agrario,* an official term used by the Mexican social property bureaucracy but rare in the "real world," where terms like *agencia municipal*, *pueblo*, and *comunidad* are more common. An *ejido* or *comunidad agraria*; in essence, the territory legally associated with a village-scale assembly of *ejidatarios* or *comuneros*.

PES "Payment(s) for Environmental Services." A program, usually operated by a government agency, which directs funds from natural resource beneficiaries (e.g., urban or industrial water users) to landowners who may incur opportunity costs by engaging in practices which protect the abundance or quality of that resource.

PHINA An online, publicly accessible database of basic facts and legal histories of Mexico's *núcleos agrarios*.

pozo Literally a "well," but used by some villagers to also refer to a spring or other water uptake point which has been only partly modified by humans. Also used by CONAGUA to mean a "motorized pump well" (in contrast with a *noria*, a well lacking a motorized pump).

PRM "Participatory research mapping": the application of "participatory methodology to make standard maps and descriptive information […] combining cartography and ethnography" (Herlihy and Knapp 2003, 307).

PROCEDE The massive Mexican federal program, enabled by the 1992 land tenure law reforms, which officially surveyed and certified the vast majority of *núcleos*, as well as (in most cases) their *grandes areas*, their individual parcels, and their individual *solares*. The program ran from 1993 to 2006, after which its functions were transferred to a smaller program called FANAR.

RAN The *Registro Agrario Nacional*, the federal agency within the SRA responsible for recording land rights to social property *núcleos*.

Resolución Presidencial A document in which the federal government "recognizes and assigns to a *núcleo* all the assets which form it, whether they be agrarian lands or resources such as waters, forests, mines, tourist or fishing resources, etcetera."

RTBC *Reconocimiento y Titulación de Bienes Comunales.* A mid- to late-20th-century effort by the SRA to more or less accurately survey, and officially recognize the existence of, *comunidades agrarias*.

social property The type of land tenure which comprises, in Mexico, *ejidos* and *comunidades*.

solar (pl. *solares*) A single lot within the human settlement area of a *núcleo*; it usually contains a house or other building. Unlike with an parcel, its owner is granted full title (*dominio pleno*) as soon as PROCEDE work is completed. The space in a *solar* adjacent to the house is sometimes called a "home garden," "kitchen garden," or "dooryard garden" (Altieri 1995, 125).

special area In PROCEDE parlance, a public right of way in a *núcleo agrario*.

SRA The *Secretaria de la Reforma Agraria*, a federal ministry established in 1974 and expanded in 1992 which handles matters of social property and national lands.

tequio The Mexican Spanish word for obligatory community work practices by members of a *núcleo agrario*. A more general Spanish term is *faena*, although this word is also used for the feudal forced labor practice called "corvée" in French and English.

toma A place where water is taken from a stream or water body for transport to a water use location.

1. Introduction

This study seeks to augment the body of scholarship focused on the evolving and spatially varied relationships among individuals in village-scale communities, particularly as this individual-community nexus is mediated or directed by the state, particularly by national governments. Mexico is an ideal place to explore these developments. Throughout its Pre-Columbian and colonial history, and as its national character was essentially forged through its early 20th century revolution, the interplay among individuals, village-sized communities, and the state has played a crucial role. This theme has taken on renewed importance in recent decades, as Mexico's democratic institutions rapidly modernize, and as its ties to the global economy and culture are ever strengthened.

The interplay among individuals, village-scale communities, and the state is continuously and eternally evolving. However, distinct, concentrated episodes do periodically occur when the evolution is especially rapid and profound. One such episode took place in Mexico, and in many other countries, during the 1990s and early 2000s: the neoliberal state ideology which produced legal reforms in land tenure, natural resource management, and the protection of domestic products in the global marketplace. The most conspicuous reaction to these reforms was the indigenous-dominated Zapatista Rebellion in Chiapas state in 1993. This study compares certain geographical aspects of village culture as they were practiced before and after the neoliberal reforms.

Land tenure practices and their relationships to place-specific natural resources are geographic subject matters which are especially sensitive to these individual-village-state interactions, both materially and symbolically. For this study, I chose to focus on the natural resource of water, particularly the *water source* – any place, representable on a map as a point, where humans have invested in infrastructure to divert water from its natural path for their own use.

Most scholarship has concentrated on village-scale, regional, and national water rights structures and practices in water-poor areas, where irrigation – the artificial transport of water for agricultural use – is common (e.g., Worster 1985; Yetman 2000; Boelens and Gelles 2005;

Wilder and Whiteford 2006). I chose instead to focus on water-rich areas, where well-developed rights structures are less likely to already be in place. These communities may thus be more vulnerable to legal and cultural difficulties, as changing water rights and land tenure practices collide with an increasing regional demand for water – a demand augmented by population movements, climate changes, and a shift from subsistence farming to commercial (especially export) agriculture.

Two caveats must be acknowledged. First, except in a few places in the world, it is unlikely that water will ever be a "resource curse" to the degree that, for example, petroleum has been in Nigeria. In general, long-distance water transport is rarely feasible or economically necessary, and when it does occur tends to only affect a few villages directly.[1] Second, water is in some ways a poor choice to study in connection with land tenure. In physical terms, water of its own accord often transports *itself* from one property to the next. In legal terms, the Mexican Constitution (Article 27, paragraph 5) states that water is fundamentally owned by the nation as a whole.

At the very least, the symbolic power of water can be enormous, and this symbolism can have real political and social consequences. This can be especially conequential in indigenous areas where, almost by definition, important aspects of territorial claims predate the state and thus stand partly in opposition to it.[2] Furthermore, just through the process of investigating the water source ownership and management practices, one can learn important facts about land tenure in general, and about the relationships among the village, the individual, and the state. The findings arising from such research are more likely to be accurate and valuable when much of the data is collected through methods such as participatory research mapping (PRM) and a close reading of previously untranslated documents stored in public archives not accessible through the Internet (the PRM technique is described in subsection 3.2, on pages 73 and 74).

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[1] In section 1.3 I review examples of long-distance and medium-distance water transport systems in Mexico.

[2] For example, in their 2003 proposed changes to the Peruvian Constitution, a coalition of indigenous groups stated that "indigenous or ancestral peoples predate the state and have their own social, economic, cultural, and political institutions, their territory and they identify themselves as such" (Parellada 2003, 135).

1.1 Hypothesis and main concepts

My hypothesis is that indigenous, water-rich communities in Mexico are maintaining the same degree of village-scale control (meaning, management and locally-defined "ownership") of water sources that they practiced before the neoliberal land tenure reforms of the 1990s.

1.1.1 Land tenure, neoliberalism, and social property

As the 1991 breakup of the Soviet Union seemed to signal the triumph of free-market capitalism over state-planned economies, global finance organizations such as the World Bank and the International Monetary Fund increased their pressure on states in the developing world to lead the charge in a "neoliberal turn," toward state mechanisms which support "strong individual property rights, the rule of law, and the institutions of freely functioning markets and free trade" (Harvey 2005, 64). Mexico's federal government enthusiastically embraced this shift in 1992 when the Harvard-trained president Carlos Salinas de Gortari, encouraged by the World Bank, saw an opportunity to renew the vigor and esteem of his Institutional Revolutionary Party (PRI) through constitutional and statutory reforms (Loewe and Taylor 2008, 7). The PRI had controlled the country for seventy years but was starting to lose the confidence of the Mexican public, particularly since a 1982 debt crisis driven by overdependence on volatile oil exports (Collier 2005, 88).

A caricature of the neoliberal ideal of property, common since Friedrich von Hayek popularized neoliberal economics in his 1944 book *The Road to Serfdom*, is one of pure, individual ownership, unfettered by any communal or government interest or intrusion. In actuality, even the most ardent pro-market, pro-privatization advocates recognize that any piece of land has a complex bundle of rights and obligations through which human beings (as individuals, groups, and states) choose to link it to other human beings (Powelson 1988, ix; Demarest 2011, 264). According to economist and social theorist Thomas Sowell (1980, 213), "every economic activity under every conceivable form of society has been planned. What differs are the decision making units that do the planning."

Likewise, left-leaning social scientists and other advocates for indigenous rights and cultural survival have been caricatured as promoting a romantic ideal of purely communal land tenure. This ideal is well expressed by, for example, independent anthropologist Jaime Martínez Luna, resident of a village within this dissertation's study areas (Martínez Luna 2003, 22). Any scholar, no matter how sympathetic to village-based and indigenous cultures, understands that all social situations include both individual and communitarian elements (Rendón Monzón 2003). Political scientist Todd Eisenstadt (2011, 71) recently observed that:

> The macro-historical processes underlying group solidarity in Chiapas and individualism in Oaxaca underscore the micro-institutional differences in each state's land tenure structure. Rural dwellers in Chiapas made the transition from corporatist subjects to democratic (or quasi-democratic) citizens as a result of solidarity, collective action, and the formation of region-wide social networks surrounding the Zapatista movement. This contrasts markedly with political developments in Oaxaca, where colonial legal deeds to entire villages gave citizens control and a sense of political autonomy that allowed for individually-based property rights and community relations.

In sum, neither a purely private property regime, nor a purely social one, has ever existed in practice. Any system will be a negotiation, a contested set of practices at village, multi-village, and pan-ethnic scales, with experiments and hybrid solutions as responses to internal and external events and pressures:

> Eric Wolf and other anthropologists reformulated the concept of closed Indian communities. Instead of being the remnants of Mesoamerican civilization, the tightly knit villages in Oaxaca and elsewhere in southeastern Mexico were seen as the product of a Spanish colonization strategy that sought to isolate and divide Indian peoples. Indian villagers themselves took advantage of these 'closed, corporate communities' to isolate and defend themselves against the incursion of outsiders.
>
> (Barry 1995, 180, paraphrasing Wolf 1986)

> What is especially worrisome is that the discourse of consensus [in indigenous Chiapas] has been transformed into a demagogic instrument to justify to outsiders all sorts of excluding, authoritarian, and anti-democratic practices, under cover of a supreme right to distinctiveness and a defense of 'traditional' culture.
>
> (Sonnleitner 2001, 125)

The renewed emphasis on individual land ownership is just one element of the neoliberal turn. Other elements include increased commercialization and monetization of human practices; increased mobility of goods, information, money, and people (which, in rural Mexico, often translates into ever-increasing roles for emigration and remittances); and, a call for (supposedly) universally shared individual rights to prevail over certain local cultural norms, even at the cost of loss of autonomy and distinctiveness among indigenous groups and ethnic minorities. Even within the specific realm of land tenure reform, the neoliberal emphasis is not just on the private individual, but also on the more general task of bringing the state's de jure records (i.e., expanded cadastre) into alignment with the de facto reality of land tenure practices. Ironically, by requiring the state to impose its standards on local property systems, this effort runs counter to the overall neoliberal goal of reducing the state's presence. Historian Raymond Craib (2004) tells how the Mexican state enacted a similar property surveying effort during the late 19th-century Porfiriato period to which the Mexican Revolution was a violent reaction – roughly simultaneously with the Dawes Act (1887) and Curtis Act (1908), through which Indian tribes in the United States were forcibly assimilated through the privatized individualization of their land tenure (McDonnell 1991, 15).

In this study, the term "social property" refers to all lands where the post-Revolution Mexican federal government gave legal recognition to a village-scale group of persons as de jure owners of a defined territory. By the 1980s, about fifty percent of Mexico's land area was social property (INEGI 2001a). A social property village in Mexico is either an *ejido,* its land granted by the state following the expropriation of a large private property, or it is a *comunidad agraria* (often called simply a "*comunidad*"), its land identified as having been in possession of the villagers "since time immemorial" (INEGI 2007). About 91 percent of social property villages are *ejidos* (de Gortari 1997, 16). In legal documents, *ejidos* and *comunidades* – i.e., all social property villages – are collectively called *núcleos agrarios,* or just *núcleos*.

It must be stressed from the outset is that "social property" and "indigenous" are not equivalent terms. Unlike in some other countries, in Mexico "indigenous" as a legal designation attaches neither to individuals nor to territories (Roldán Ortega 2004, 12), although the concept is applied for government planning purposes and does appear in various local, state, and nationwide statutes. Within social property, nearly all residents of *comunidades* (known as *comuneros*) are indigenous in some sense, but only about half of the *ejido* residents (known as *ejidatarios*) are indigenous. Almost one third of Mexico's *comunidades* are in the state of Oaxaca (de Gortari 1997, 19), which is also the state with the highest diversity of indigenous languages (de Ávila Blomberg 2004, 483).

1.1.2 The village and the *núcleo*

A *núcleo* is a legally-defined territory in the social property areas of Mexico smaller than a *municipio* (county) (INEGI 2007). Each *núcleo* is simultaneously a piece of property and a jurisdictional unit (administrative area). As a property, it is or was collectively owned by a well-defined group of people who are a subset (usually a majority, occasionally all) of the heads of household who live within the *núcleo.* If the *núcleo* is an *ejido*, these members are called *ejidatarios*; if it is a *comunidad*, they are called *comuneros*. As a jurisdictional unit, the *núcleo*'s population is larger than this membership list: it includes spouses, children, non-member heads of household (sometimes called *pobladores* or *avecindados*), and, increasingly (though still uncommonly), ex-members who have chosen to fully title their individual agricultural parcels through *dominio pleno* (fee simple), a process enabled by the 1992 agrarian reforms. I use "villagers" or "village residents" to refer to all the people living in a *núcleo,* and "*ejidatarios*" or "*comuneros*" to refer to just the *núcleo* members.

In most respects, a *núcleo* is a village. If you ask someone where they live, they will usually give you the name of their *núcleo,* though they will probably think of it as a *pueblo*, *comunidad*, or *ejido*, because the term "*núcleo*" is a recent legal invention of the Mexican government. Most decisions associated with village life are made by the assembly of *núcleo* members, and whatever village rituals and collective activities still exist mainly operate at the *núcleo* scale. Among Mexican indigenous groups, the awareness or recognition of larger ethnic territories is generally understated or inactive when compared to most indigenous groups in, for example, Central America. Even the Huichols, a Mexican indigenous group noted for its unusually high degree of regional-scale territorial actualization, acquire formal landowning power only at the *núcleo* scale (Liffman 2011, 18).

Why do I use the word “village” at all in this study? Why do I not simply always use *núcleo*? I do this because the word “village” is more broadly applicable. It has a particular (though not always precisely defined) geographic meaning which allows comparison with situations in countries beyond Mexico. Even just within my geodata analysis areas, “village” can refer to congregations of households that are not *núcleos,* because they are not social property. In some cases, such villages were clearly never associated with social property practices, and function much like villages or townships in the United States. In a few cases, some social property ethos did (and probably still does) exist in the village, but a federal judge has decided that not enough exists to bestow official recognition as a *núcleo*.

When I discuss village-scale practices and culture in contrast to other scales (e.g., the individual scale), I generally use the word “village.” For example, in chapter 6, I contrast village-scale water items (e.g., potable water supply for homes) with sub-village-group-scale items (e.g., a shared irrigation system) and individual-scale items (e.g., a 50-m length of hose carrying water from a stream to an individual’s coffee processing place). I use “practice” to mean a human action which is repeated by many people, usually over a span of time. An “item” is a material cultural artifact which embodies a practice. A set of practices may together suggest an “orientation”; in this study, I focus on “village-scale orientation” and “individual-scale orientation.” For brevity, I will often omit the word “scale.” In place of “orientation,” I might have used “inclination” or “ethos.” “Worldview” is another near-synonym, one which I avoided due to the essentialist connotations some ascribe to it (Beine 2010, 2).

Why do I use the word *núcleo* at all? Why not always use “village” instead? I do this because it is the more precise, unambiguous term for the units associated with most of the data in this study. For example, I researched hundreds of documents in various National Agrarian Registry (RAN) archives; these papers are separated into a separate folder for each *núcleo*. Similarly, my participatory research mapping was conducted as essentially separate projects in each of 13 *núcleos*. Only my geodata analysis areas are defined not by *núcleos,* but rather by 1:50,000-scale government-produced topographic maps; but even the geodata findings depend partly on *núcleo*-scale land tenure information.

If I were to use “village” when referring to data pertaining to an entire *núcleo* territory, one ambiguity which could arise is that “village” is also used colloquially to refer to a compact population center, in contrast to the fields and forests around it. I use three terms for such a congregation of houses and buildings. The general term is “population center.” When discussing *núcleos* which have had government land survey work done since the 1992 reforms, I use a more specific phrase: “human settlement area” (*asentamiento humano*). This is a legal term used by RAN (along with with “urban zone”) for a population center which has been formally surveyed as such (INEGI 2007). Since the 1992 reforms, nearly all *núcleos* whose agricultural areas have been certified as individual parcels have also had their human settlement areas fully titled – not just certified – as individual house lots (*solares*). Because certification is merely a step toward titling, the distinction is important.

Sometimes a *núcleo* includes several human settlement areas within its territory. Usually, one of these is clearly a “village” while the others are better characterized as “hamlets,” and the inhabitants of the hamlets consider themselves residents of the entire *núcleo.* In a few cases, however, two or more village-sized settlements have been included within a single legally defined *núcleo* territory. In such cases the residents generally identify most strongly with their particular village, and see the fact that they share a *núcleo* with another village as a mere technicality, and sometimes also as a point of conflict.

A third term for a population center is “*localidad*,” a technical term with two distinct meanings. The federal census and cartography agency INEGI uses the word to refer to a rural census tract, conceived as a point on the earth’s surface representing a collection of homes ranging in scale from a farmstead to a small town. RAN uses “*localidad*” to refer to a village-scale entity which lies within a *municipio* that is mainly social property, but is not itself a *núcleo* nor part of any *núcleo* territory, although its residents can be members of a neighboring *núcleo* (INEGI 2002b).

Talea, the *núcleo* in the state of Oaxaca where I conducted the most thorough participatory research mapping for this study, is an odd case whose peculiarity illustrates the importance of using these terms properly. It appears to be a normal *núcleo*, with a bustling population center, a secondary hamlet, fields, orchards, and forests. However, during the PROCEDE process, the *núcleo* members chose to separate their territory into two entities. The *núcleo* proper includes the fields, the orchards, the forests, and the secondary hamlet. The second entity, the population center where most of the *núcleo* members (and other residents) live, is a separate unit whose boundaries were technically never surveyed by PROCEDE, though in effect they were, since the inner boundary of the *núcleo* "donut" is identical to the outer boundary of the population center "hole." This population center is a *localidad* in the sense used by RAN, and its affairs are administered by the *municipio* (county) of which Talea is the seat (*cabecera*). The two entities have distinct legal names: the *núcleo* is "San Miguel Talea de Castro," while the *localidad* is "Villa Talea de Castro." For most purposes, however, it would be ridiculous to think of both entities as anything but a single village, one which local people refer to as "Talea" when speaking Spanish, or "Raleha" when speaking Zapotec.

1.1.3 The PROCEDE process

In this study, "PROCEDE" is used to refer to the project of neoliberal land tenure reform in Mexico. PROCEDE is an acronym for *Programa de Certificación de Derechos Ejidales y Titulación de Solares Urbanos* (Program for Certification of *Ejido* Rights and Titling of Urban Lots), the massive surveying, certifying, and titling effort which the Mexican federal government undertook from January 1993 to December 2006, after changes to the federal Constitution in January 1992 allowed for the individual ownership and eventual privatization of social property parcels. The program represented a temporary collaboration among three federal agencies: the *Procuraduría Agraria*, a legal bureau which communicated with and assessed *núcleo* members; the RAN, which registered and distributed certificates and titles; and INEGI, which supervised the actual surveying work and its cartographic products (Zepeda Lecuona 1998, 6). In each *núcleo*, work proceeded in seven stages: coordination and agreement; raising of awareness among all [*núcleo*] residents; informational meeting; meeting for the report of the Auxiliary Commission [*núcleo* leaders in their role as assistants to the surveying process]; surveying and production of maps; the *Asamblea de Delimitación, Destino, y Asignación de Tierras* (meeting to ratify the delimitation, purpose, and assigned ownership of lands); and the distributing of legal documents (Zepeda Lecuona 1998, 7).

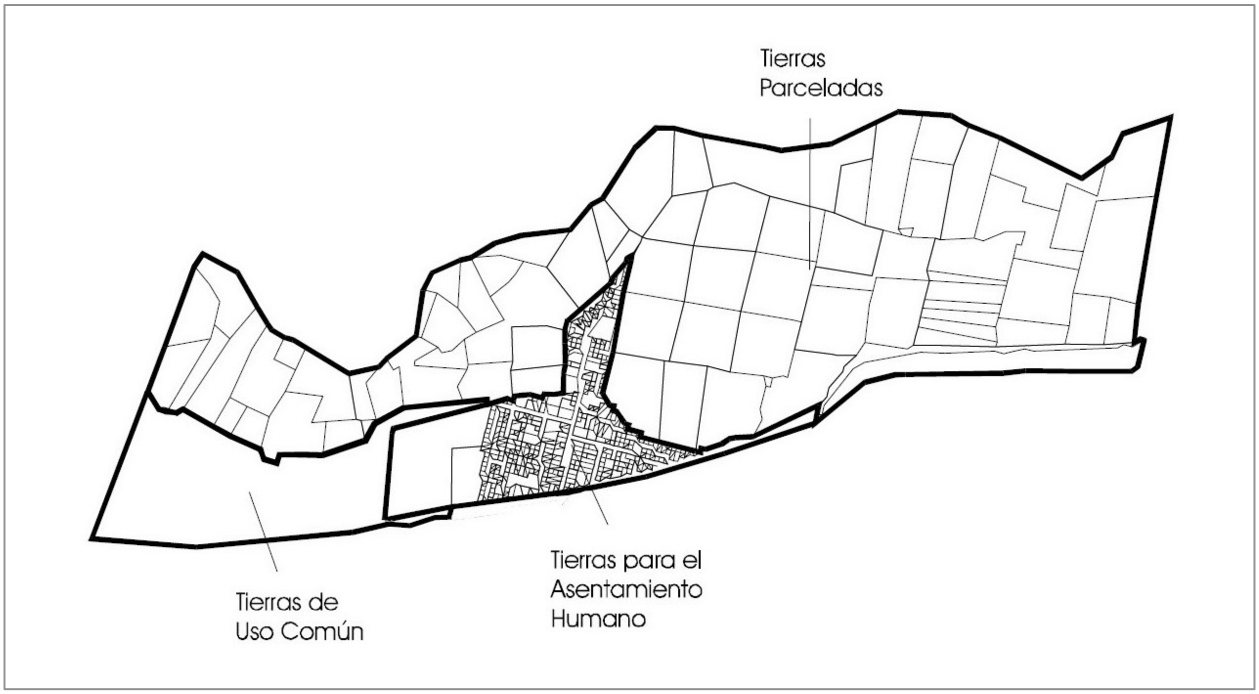
Before PROCEDE, formal, legal descriptions of individual parcels were unstandardized, haphazardly archived by government entities at various scales, and of limited utility beyond the *núcleo* itself. In the *comunidad* of Cuatlamayán, the México Indígena team was "shown an example of a legally binding, yet non-PROCEDE, hand-drawn parcel map, produced locally with assistance from the federal indigenous institute" (Herlihy et al. 2008, 67). With or without such written documentation, parcel transactions did occur in nearly all *núcleos*, as well attested in the literature and in the present study (chapter 5). These transactions varied in their degrees of formality and legality, from entirely legal inheritance by an owner's child, to quasi-legal transactions among residents of a *núcleo*, to illegal transactions with outsiders.

By the end of the PROCEDE program in 2006, 91.2 percent of the country's officially recognized *ejidos* and *comunidades* had had at least their territorial perimeters surveyed, and the great majority of these also had individual parcels surveyed and certified (INEGI 2008). The "holdouts" to individual parcel surveying were mainly concentrated in certain indigenous, rugged areas of the southern states of Oaxaca and Chiapas, as well as other pockets of resistance such as the 1980s-settled *ejidos* in the Calakmul forest of Campeche. Many of these *núcleos* rejected the program explicitly, while others were not allowed to undergo PROCEDE work until certain boundary conflicts with neighboring villages or landowners were resolved. Since 2006, the government has extended the lifespan of PROCEDE (although without PROCEDE's no-cost guarantee) through a successor program called FANAR (*Fondo de Apoyo para Núcleos Agrarios sin Regularizar*, "Assistance Fund for Unregularized Agrarian *Núcleos*") in the expectation that many de facto individual parcels in remaining non-PROCEDE-parceled *núcleos* will eventually achieve de jure status through certification.

In this study I compare individual and village orientation before and after the 1992 reforms. For those study *núcleos* which underwent PROCEDE or FANAR surveying, the actual work occurred at various times during the first 15 years (1993 to 2008) of reform implementation.

In their standard template for PROCEDE and FANAR work (Figure 1.1), the government envisioned that most *núcleo* assemblies would chose to have their de facto tenure areas legally divided into areas among three tenure types, collectively called *grandes areas* ("big areas"). The

Figure 1.1. Standard template for PROCEDE surveying and certification, as depicted in publicly distributed PROCEDE reports as a map of an unnamed or fictitious *núcleo.* (Source: INEGI 2006b, 3).

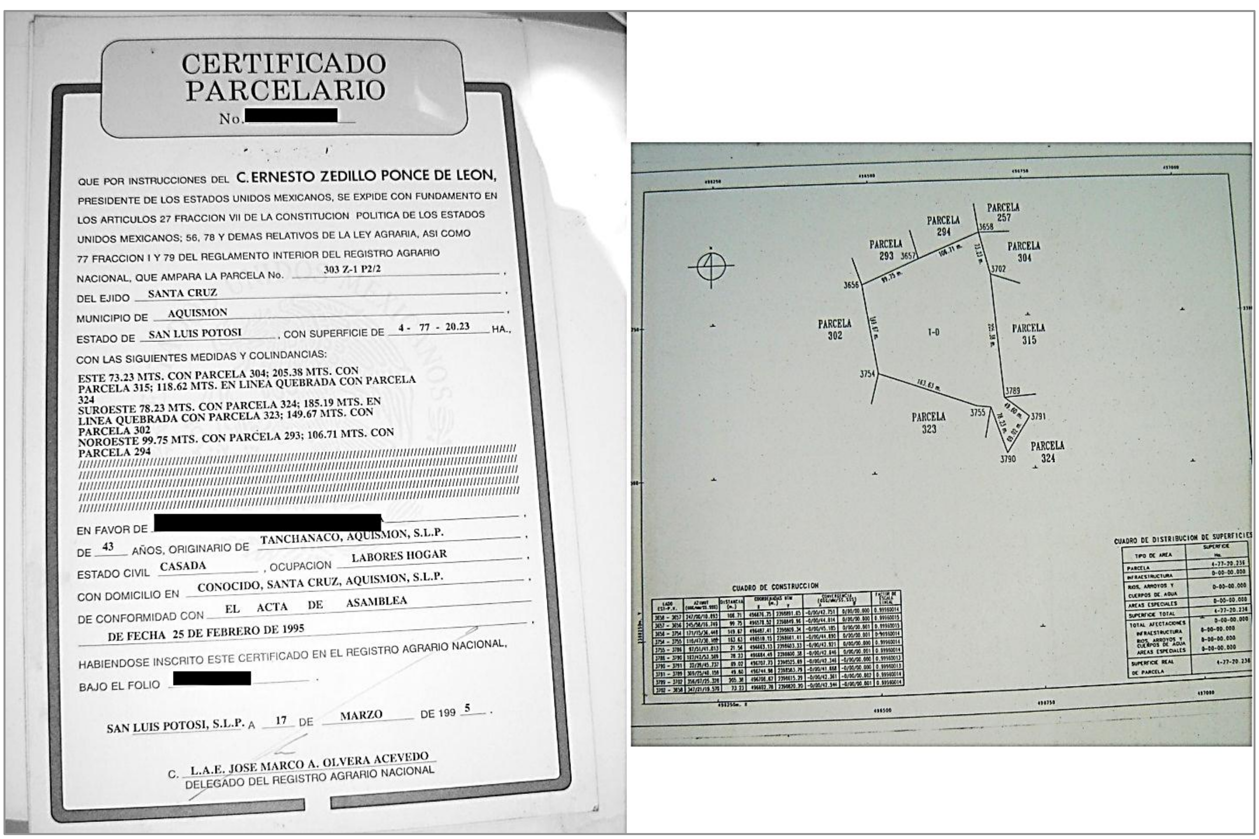


three tenure types are common use areas, parceled areas, and human settlement areas. (Figure 5.3 on page 211 shows part of a PROCEDE parcel area map, while Figure 6.7 on page 261 shows the pattern of individual PROCEDE-surveyed parcels in another *núcleo*.)

Each land tenure type is linked to individual persons via a distinct legal document. If there are one or more PROCEDE-surveyed common use areas, each *ejidatario* or *comunero* receives a certificate stating that they share in their ownership of the entire area, even though in some cases de facto individual parcels (often temporary ones) do exist within them (Smith et al. 2009, 182). If there are PROCEDE-surveyed parceled areas, each *ejidatario* or *comunero* receives an individually customized certificate (Figure 1.2), including a legal description of neighboring properties, a GIS-drawn map of boundary segments and vertices, and a list which gives both relative azimuths and distances of boundary segments and absolute vertex coordinates, often in UTM, with centimeter precision. If an *ejidatario* or *comunero* owns several parcels, as is typical, he or she receives a separate certificate for each one. While a parcel certificate confers to an individual an unprecedented degree of direct legal ownership over a well-defined plot of land, it is not a full title (*dominio pleno*); I will discuss *dominio pleno* in the next sub-section.

If there are one or more human settlement areas, each *ejidatario* or *comunero* receives full title (*domino pleno*) for their *solar* (house lot) without the need for further steps. Evidently, the neoliberal reformers in the Mexican government deemed that the post-Revolution social property promise was, at most, directed toward agricultural lands and other relatively large plots, despite the fact that much food production and biodiversity management does in fact take place on *solares* (Ayalón-Gamboa and Gurri-García 2008; Aguilar-Støen, Moe, and Camargo Ricalde 2009).

Figure 1.2. Front (left) and back (right) of a parcel certificate delivered to an individual *ejidatario* after PROCEDE surveying. "C. Ernesto Zedillo Ponce de León" was the president of Mexico when the parcels and common use areas of this Huasteca study *núcleo* were surveyed. Personal information is redacted. (Source: México Indígena database).



CERTIFICADO PARCELARIO

No. [redacted]

QUE POR INSTRUCCIONES DEL C. ERNESTO ZEDILLO PONCE DE LEON, PRESIDENTE DE LOS ESTADOS UNIDOS MEXICANOS, SE EXPIDE CON FUNDAMENTO EN LOS ARTICULOS 27 FRACCION VII DE LA CONSTITUCION POLITICA DE LOS ESTADOS UNIDOS MEXICANOS; 56, 78 Y DEMAS RELATIVOS DE LA LEY AGRARIA, ASI COMO 77 FRACCION I Y 79 DEL REGLAMENTO INTERIOR DEL REGISTRO AGRARIO NACIONAL, QUE AMPARA LA PARCELA No. 303 Z-1 P2/2,

DEL EJIDO SANTA CRUZ,

MUNICIPIO DE AQUISMON,

ESTADO DE SAN LUIS POTOSI, CON SUPERFICIE DE 4 - 77 - 20.23 HA.,

CON LAS SIGUIENTES MEDIDAS Y COLINDANCIAS:

ESTE 73.23 MTS. CON PARCELA 304; 205.38 MTS. CON PARCELA 315; 118.62 MTS. EN LINEA QUEBRADA CON PARCELA 324

SUROESTE 78.23 MTS. CON PARCELA 324; 185.19 MTS. EN LINEA QUEBRADA CON PARCELA 323; 149.67 MTS. CON PARCELA 302

NOROESTE 99.75 MTS. CON PARCELA 293; 106.71 MTS. CON PARCELA 294

EN FAVOR DE [redacted],

DE 43 AÑOS, ORIGINARIO DE TANCHANACO, AQUISMON, S.L.P.,

ESTADO CIVIL CASADA, OCUPACION LABORES HOGAR,

CON DOMICILIO EN CONOCIDO, SANTA CRUZ, AQUISMON, S.L.P.,

DE CONFORMIDAD CON EL ACTA DE ASAMBLEA

DE FECHA 25 DE FEBRERO DE 1995,

HABIENDOSE INSCRITO ESTE CERTIFICADO EN EL REGISTRO AGRARIO NACIONAL,

BAJO EL FOLIO [redacted].

SAN LUIS POTOSI, S.L.P. A 17 DE MARZO DE 1995.

C. L.A.E. JOSE MARCO A. OLVERA ACEVEDO

DELEGADO DEL REGISTRO AGRARIO NACIONAL

Different *núcleo* assemblies chose to allow distinct types of PROCEDE work to take place in their territories. In other words, only a subset of *núcleos* conformed to the standard government template depicted in Figure 1.1. In contrast some of those *núcleos* which did not do PROCEDE work at all, all *núcleos* which did "partial" PROCEDE work did so entirely on their own accord, never because existing conflicts or other issues caused the government to disallow participation. The spatial pattern such resistance and partial accommodation to PROCEDE is highly clustered, as a brief look at Figure 7.1 (page 300) and Figure 7.2 (page 305) reveals. In 27 percent of the PROCEDE-parceled *núcleos*, the "resistance" took the form of not including any common use area (INEGI 2008); that is, in at least one sense, the villagers chose to apportion their territories in a *less* "village-oriented" manner than envisioned in the template. This was sometimes because no de facto common use area existed previously, and other times because a highly individual-oriented *núcleo* took the opportunity to divide up a common use area among its members (Hernández Cendejas 2008).

Among my 33 RAN document study *núcleos*, PROCEDE was more commonly resisted and accommodated instead by having *some* surveying work done, but stopping short of creating any areas with de jure individual parcels. Figures 5.1.1 through 5.1.9 (pages 195 to 203) depict in map form the types of PROCEDE surveying and certification work performed in all 33 *núcleos*, and are arranged in order from "least PROCEDE work" to "most PROCEDE work." Lighter colors represent more village-oriented de jure land tenure areas, while darker colors show more individual-oriented ones. The most basic PROCEDE survey is simply of the *núcleo* territorial boundary, a step often taken to prevent future inter-village boundary disputes (Figures 5.1.3 to 5.1.5). Some *núcleos* (Figure 5.1.5) took the step of having PROCEDE certify a few individual parcels for civic purposes, while leaving the actual parceled areas in legal common use, thus inverting the intentions of the program. Figure 5.1.6 depicts *comunidades* which conformed most closely to the standard template by having individual parcels certified, while Figure 5.1.7 and 5.1.9 show *ejidos* which did this; but even in these *núcleos*, there were interesting variations which I will discuss in other sections.

In addition to the three *grandes areas* (land tenure types), in maps and documents PROCEDE would usually dedicate a small portion of a *núcleo*'s land to a fourth type sometimes called "special areas," and other times "infrastructure and other." These are essentially rights-of-way or easements, for purposes beneficial to the public beyond the *núcleo* such as highways and waterways. This tenure type was rarely explained clearly in the same brochures which described the *grandes areas* (the narrow, hockey-stick-shaped polygon near the southern edge of the parceled area in Figure 1.1 represents one, albeit unlabeled). Its status in the official documents is also confusing: it is apparently not owned by the *núcleo* itself (though it is under its jurisdiction), nor by any of its individual members, but its area is nevertheless included in some lists of *gran area* totals. I will explain in sub-section 1.1.6 how these "special areas" relate to Mexican constitutional concepts of water, and consider specific examples in sub-section 6.1.2.

1.1.4 Defining "privatization" in the context of PROCEDE

The 1992 neoliberal-influenced land reforms in Mexico were realized through changes to both the Constitution (Cámara de Diputados 2004), and to the Agrarian Law which regulates and directs actual policy (Congreso de los Estados Unidos Mexicanos 1992). "The changes aim at giving legal tenure security while promoting capitalization, protection, and strengthening of agricultural communities through *ejidal* and communal property" (Herlihy et al. 2008, 10).

Once a *núcleo* has had its individual parcels surveyed, several more steps must be taken before any parcels are fully privatized (*dominio pleno*). If it is a *comunidad*,[3] it must decide to convert itself into an *ejido*; "In a twist that may exaggerate the difference between *comunidades* and *ejidos*, the 1992 reforms […] specifically spelled out that only *ejidos* would be allowed to gain full, private rights and land titles" (Perramond 2010, 52). I am aware of just two *comunidad*-to-*ejido* conversions within my geodata analysis areas, the *núcleos* of La Palma and Ixtlapalaco in the Huasteca (Ledesma Barragán 2009).

If it is an *ejido*, first the village assembly must approve the *possibility* of full title, by a two-thirds majority (Brown 2004, 20). Then, finally, any individual *ejidatario* can obtain this title, by taking the following steps which appeared in posters at each state RAN office: "1. Pay 180 pesos; 2. Go to RAN with elector card and original parcel certificate, and fill out form

[3] Legally speaking, in a *comunidad*, the *núcleo* is the owner (*dueño*), while the individual is the worker (*trabajador*), authorized by that owner to work its land – exactly as a private, individual owner of an *ejido* parcel could authorize anyone to work their land (Ledesma Barragán 2009).

Solicitud de la Expedición de Títulos de Propiedad para la Adopción de Dominio Pleno sobre Parcelas; 3. Wait 90 days; 4. Go to RAN to pick up title." From that point on, the document will be filed in the county's cadastral office, just like any other private lot – and, incidentally, the state can keep track of its ownership every time it changes hands, something it was unable to do during the full social property era.[4] So far, this happens rarely; as of 2006, "only 0.94 percent of the social sector's surface area and 0.43 percent of the *ejidos* have adopted full ownership; most of these are situated in peripherally urban areas, and thus are interested in selling their lands at a higher price" (de Ita 2006, 158).

Some would argue that PROCEDE only equates with "privatization" for those few (so far) parcels which have attained full individual title in this way. Others, however, point out that there are two other changes in the laws which could be interpreted as a partial "privatization." The first is that the certificate given to each *comunero* or *ejidatario* acknowledging their usufruct rights to the *common use area* (which, for *núcleos* with only the perimeter surveyed, means the entire *núcleo*) can now be transferred to someone else within the *núcleo* (Lonzano 2008). In practical terms, this means that an individual villager can collect (surely meaning "buy") many common use certificates. By itself, this change is not extreme (Linck 1999, 132).

The second change is that now, the *núcleo* can grant leases – "association agreements" – to third parties to use their common use land for a period of time (Lonzano 2008). This is also not a radical change in itself. *Ejidos* and *comunidades* have always granted concessions, to timber companies and other commercial concerns, for the extraction of natural resources from their land. The new law modernizes and standardizes this process, bringing it closer to the kind of business deal where the *núcleo* members, as "junior partners," are a step further away from controlling their property. I suspect that it is the combination of the first and second changes which will bring some villagers closer to individualized land-based commercial enterprise, leaving other villagers out of the deal. The Mexican leftist scholar and political organizer Julio Moguel asserted (1998, 17):

[4] The Mexican cadastral system is embedded in its statutory law, but its basic principles of an updated state registry (in place of a complex history of deeds for each property) were first enshrined in a common-law context, by South Australia's premier Robert Torrens in 1858 (Linklater 2003, 210).

> The new legislative frame also changes the legal condition of the indigenous community – which, we have seen, can move to privatization if it first converts to an *ejido* regime. But it can at the same time 'associate itself' and transmit the domain of common use areas to merchant and civil societies. This path to privatization was ratified and extended by the Forest Law approved in 1992, under a scheme similar to that put in place by the military junta in Chile in 1974, which based it in large pine and eucalyptus plantations.

The words "private" and "property" share a Latin root meaning "one's own, belonging to an individual, set apart from state or public ownership" (closely related words include "proper" – apt for a single purpose – and "property" in the sense of a characteristic of a single thing or person). In the context of Mexican rural land tenure, most legal scholars and real estate agents clearly equate it with full individual title (*dominio pleno*). Anyone who uses the word "private property" to refer to communities which only had their external boundary surveyed by PROCEDE, for example, risks being misunderstood by many.[5]

A case can be made, however, that on a more philosophical level, aside from any practical effects it may or may not have, the mere existence of a program like PROCEDE can color the cultural atmosphere of an entire country with its neoliberal penumbra – that, in a sense, any *núcleo* which does any kind of PROCEDE work, or even is anywhere near a *núcleo* which does, is somehow "guilty by association" (see, e.g., Pous and Vilanueva 2005). I do not recommend calling this reflected aura "privatization," but perhaps "virtual privatization" is an apt term: virtual in both the cyberspatial sense of "simulated," and in the temporal sense of "approaching, but not yet arriving."

Karen Bakker (2010a, xv), referring to urban water provision, contends that when we use the word "privatize" to mean anything remotely commercial, or anything not entirely owned and controlled by the state, we are losing its power as a descriptive term:

---

[5] Among some indigenous cultures, simply the surveying of territorial boundaries, even if it is to codify communal tenure, can be detrimental and antagonistic to local traditions and practices (Herlihy 2011; Unruh 2006). As I will examine in chapter 5, this sometimes is a problem at the sub-village level in Mexico, but to my knowledge is not generally an issue for nucleos or larger territories, except in regards to unusual situations such as the Huichol ritual pilgrimages from their villages in the Sierra Madre Occidental to a semi-arid part of San Luis Potosí state (Schaefer and Furst 1997).

> Some [reserve] the term *privatization* for the sale of assets to the private sector – in other words, the private ownership of water-related infrastructure. In this case, the terms *private sector participation* and *public-private partnerships* are used to refer to a range of contracts whereby private companies build, manage, and/or operate infrastructure on behalf of governments. These contracts include concessions, management and service contracts, consulting services, and public-private partnerships with NGOs.
>
> Others (usually opponents) use the word *privatization* as an umbrella term, to include the entire range of activities just mentioned, [because they all involve the] redistribution of governance to nonstate actors and the application of market-based norms, values, and practices in management and regulation.

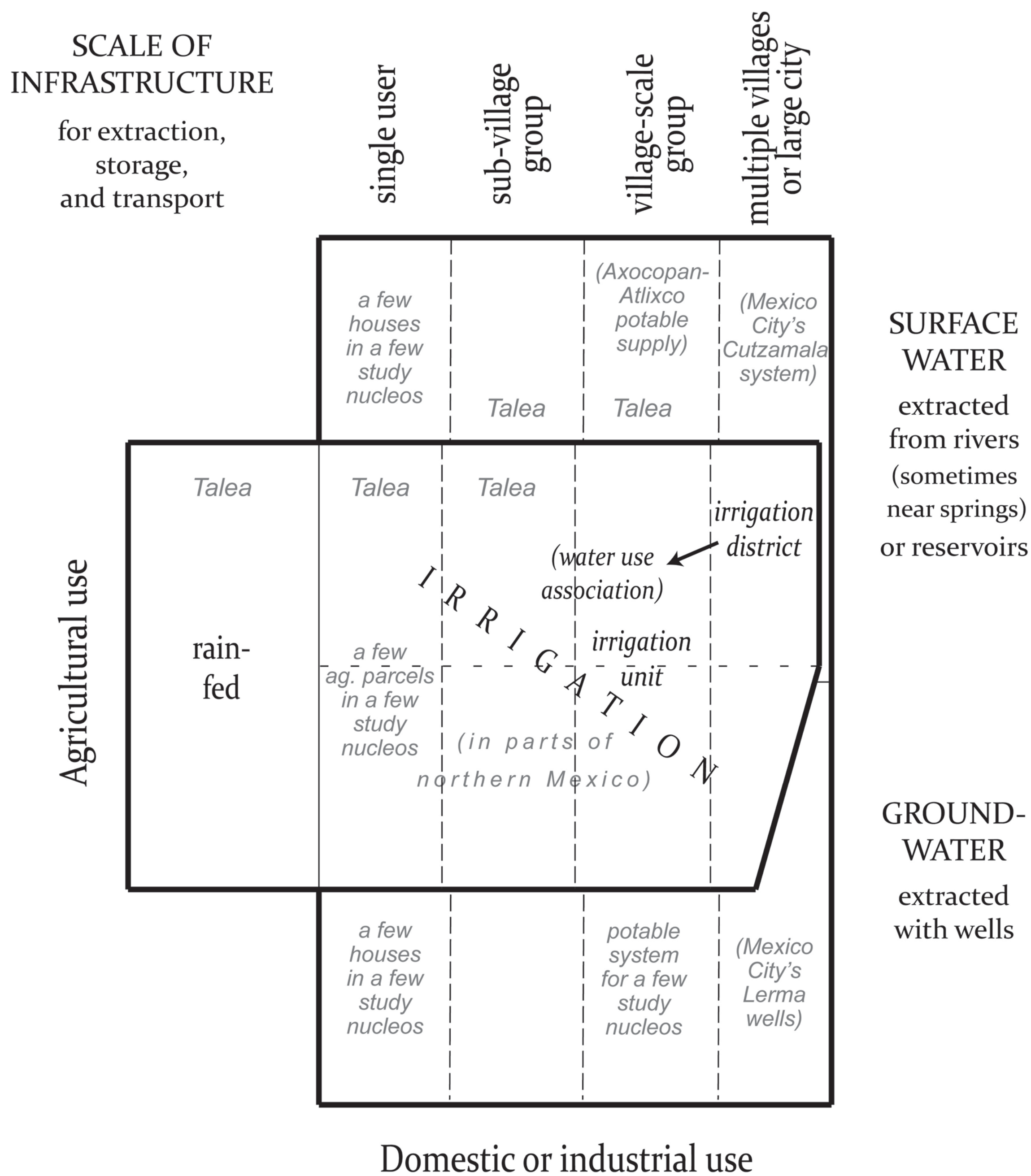
With reservations, Bakker decided to use the word in the broader sense, though not in the very broadest. She does "not use the term to refer to broader trends of commercialization of water resources and services," nor to "small-scale water entrepreneurs, nor to community groups, cooperatives, and other, usually not-for-profit NGOs that do water work – it is unhelpful to extend the term *private* to cover all non-state actors" (Bakker 2010a, xvi).

1.1.5 Water ownership and management: General concepts

To organize in my own mind the complexities of human water use in Mexico and similar countries, I drew a diagram (Figure 1.3) which synthesizes information from many sources to show terminology (in black type) as well as examples from my study areas or elsewhere in Mexico (in gray type).

There are three variables. The first is the *type of use* – agricultural or domestic/industrial – represented by two overlapping rectangles. 80 percent of the water used by humans in Mexico is for agriculture (Wilder and Whiteford 2006, 346). All domestic/industrial water must be transported to the user, while only some agricultural water must be transported. The agricultural water which isn't transported is here labeled as "rainfed" (*temporal* in Spanish), and obviously only exists where there is enough rain, annually and/or seasonally, to sustain a particular crop. "Irrigation" is simply refers to water which is a). transported, and b). used for agriculture. 50 percent of Mexico's agricultural production, and 70 percent of its agricultural exports, is irrigated (Wilder and Whiteford 2006, 346).

Figure 1.3. Categories of human water use (schematic), with example locations (in gray) from this study. The three variables are "type of use" (*agricultural* in foreground vs. *domestic or industrial* in background); "origin of water" (*surface* in upper half vs. *ground* in lower half); and "scale of user(s)" serviced by the water transport infrastructure (increasing in scale from left to right). Diagram and categories by the author.



The second variable, *origin*, refers to any water which is transported. There are two major categories: surface water and groundwater. "Surface water" is that which falls to the ground, becomes a stream (through a combination of surface runoff, and infiltration which soon emerges at a spring or pond), eventually joins a river, and flows into an ocean. Somewhere along this trajectory, the water is taken for human use and transported. The general term in Spanish for the point of uptake is a *toma.* "Groundwater" is different in that its point of uptake requires extraction via some sort of well. The water itself is usually in the phreatic zone – that is, below the water table, and produced from the same infiltration which originated as precipitation and surface runoff – but sometimes, especially in arid zones, it is in a non-renewable aquifer of "fossil water." The Spanish word *pozo* means "well," but during my fieldwork, I found that it is also used to mean shallowly-dug, roughly stone-lined, simple constructions that are more modified natural springs than true wells. Development engineers consider water extracted directly from a spring to be "groundwater" as well, as long as the spring is covered by some sort of roof such as a "spring box," because such water is less likely to be contaminated by surface pollutants and parasitic organisms, as long as nearby land uses are also regulated (Mihelcic et al. 2009, 278).

The third variable, for any transported water, is the *scale* of the infrastructure system used to capture, store, transport, and distribute the water. "Single user" usually means that the same person or household captures the water, transports it (usually over a short distance), and uses it, but – as I learned through my fieldwork – the landowner at the point of uptake may be a different person than the user. The right-hand half of "domestic or industrial use"– i.e., the domestic/industrial categories at the scale of a village or larger – represent potable water systems: running water piped to houses or businesses. These systems are often called "municipal," but I avoid that word in this study to prevent confusion with the Mexican county-level administrative unit of the *municipio.* They are also sometimes known as "public drinking water supplies," but I have avoided this phrase as well, because some "public" systems have been "privatized" (see previous sub-section). Larger cities, especially in drier areas, tend to have larger systems with longer-distance transport infrastructure. The two urban potable water systems I discuss in discuss in section 1.2 appear in Figure 1.3: Axocopan-Atlixco (a village spring supplying a nearby, medium-sized city), and Cutzamala-Mexico City (several rural reservoirs supplying a distant metropolis). In Figure 1.3 I also included the Lerma well-field, which provides most of the remaining Mexico City water supply; overall, 70 percent of Mexico's urban water supply originates as groundwater (Wilder and Whiteford 2006, 346).

I did not include water *storage* features in Figure 1.3. Either surface water or groundwater may be stored in a reservoir; i.e., an artificial lake, usually created by building a dam.[6] For groundwater, a reservoir is usually only required if it is a large system with many users, whether agricultural or domestic/industrial. For surface water, reservoirs are also common even if the system has only one, or a few, users. This is because reservoirs can be constructed to both store and also to capture surface water, for later uptake. If the artificial pond is small, such constructions are often called "check dams." For small-to-medium-sized systems of all types, another common option for water storage is some sort of tank.

In Figure 1.3, the shift in water management responsibilities mandated by Mexico's 1992 Water Law from "irrigation districts" to smaller-scale "water use associations" (see sub-section 4.5.4) is represented by an arrow.

1.1.6 Water ownership and management: Mexican law

Article 27 of the Mexican Constitution of 1917 deals with property. The first paragraph establishes that all lands and waters within the country's boundaries "correspond originally to the Nation, which has had, and has, the right to transmit their ownership (*dominio*) to individuals (*particulares*), establishing (*constituyendo*) private property" (Cámara de Diputados 2004, 14); in other words, the state retains the right to set in motion the actions by which land and water eventually comes to be owned by individuals, corporations, or groups – and the right of expropriation in the public interest. Other countries have similar legal arrangements, whether their systems are based on Napoleonic-style codes (as Mexico's is), or on common law and precedence (Nolan 2004, 15).

[6] Reservoirs, especially large ones, can also have the separate function of providing the "head" – the short-distance elevation change – necessary to generate hydro-electrical power.

Paragraphs two through six delineate the many pathways by which land, water, and other natural resources can pass from the state's "original" ownership into other hands. The possible pathways for each item are restricted to varying degrees. Generally, land is the most open of these items to other forms of ownership (although it, too, is subject to restrictions, such as the prohibition of foreign land ownership within fifty kilometers of a coast or one hundred kilometers of a national boundary). There are fewer pathways to alternative ownership for critical natural resources; for example, the nation retains "direct ownership over minerals from which metals and metalloids are extracted for industrial use" (Cámara de Diputados 2004, 14).

Water is similarly limited in its potential pathways to non-state ownership, though not as strictly as are ores or petroleum. The fifth paragraph of Article 27 explains these restrictions. The word used for "water," *aguas,* has no perfect translation in English, and implies both the substance of water as well as the geographic feature (water body or course) containing it; I will translate it here as "waters."

"Waters" with the most restricted ownership are categorized as "property of the nation," and include "those of rivers and their direct or indirect tributaries (*afluentes*), starting from the point in the watershed where the first permanent, intermittent, or occasional (*torrencial*) waters begin" (Cámara de Diputados 2004, 15). This would seem to embrace all streams except those within local, closed watersheds (a hydro-geological rarity); however, later sentences in the paragraph appear to imply that this was not the intention.[7]

"Waters" with fewer restrictions on potential ownership, but still subject to strict regulation, are those which "are located in two or more parcels (*predios*); the use (*aprovechamiento*) of these waters will be considered as a public utility, and will be subject to the States' disposition." Finally, "waters" with the fewest restrictions are of two types: "underground waters may be freely brought to light (*alumbradas*) using artificial means and appropriated by the owner of the land (*terreno*)," and water bodies or courses completely contained within a single parcel are "considered an integral part of the property" (Cámara de Diputados 2004, 15).

[7] In other words, "water is considered property of the nation; however, there is some definitional ambiguity regarding 'state' waters (surface sources that originate and are depleted within a state)" (Scott, Dall'erba, and Díaz Caravantes 2010, 3).

As a practical matter, government and private surveyors who have gradually developed the cadastral maps of properties in Mexico have had to make thousands of decisions about where an ownable land parcel ends and a non-ownable water body begins. This process is much the same whether the land parcel is social property or a private parcel. Indeed, the process is essentially the same for other rights of way, such as public roads and electrical utility lines. As I mentioned in sub-section 1.1.3, the PROCEDE and FANAR surveyors have generally handled what they perceived as public watercourses by including them in a category called "special areas," within the territorial boundaries of a *núcleo* but not part of any *gran área* (i.e., common use, individually parceled, or human settlement area).

Controversial water issues tend to revolve around two concepts, neither of which is directly related to ownership of water or land: "water rights," and "water privatization."

Water rights come into play when there is more demand for water than supply in a region. At the sub-national scale, this is primarily an issue in agricultural areas where rainfall is insufficient to support crops, so water must be either drawn from underground aquifers, or stored in reservoirs, and then either used at the site (if the well or reservoir is located on the user's property), or transported to (and distributed among) the users. If an aquifer's supply is being used as fast, or faster, than it can be recharged – or, if water, whatever its source, is transported and distributed among multiple users – the society will typically develop a system to allocate the water. At the inter-regional and national and international scales, other water allocation agreements are made when different administrative jurisdictions – provinces (states) or countries – share a single water supply, usually because an important water transport channel, whether engineered or natural, serves both jurisdictions.

In drier regions of Mexico, various water rights allocation systems have developed locally, a few dating even from before the arrival of the Spanish. The better-documented local systems include those of Sonora state (Banister 2011; Doolittle 2003) and of the Tehuacan Valley in Puebla and Oaxaca states (Enge and Whiteford 1989). These and other local systems have gradually come under the purview of the Mexican federal government, and today they are standardized through a permit (concession) system administered by the Comisión Nacional de Agua (CONAGUA). Technically speaking, CONAGUA requires most water users to obtain permits even in well-watered regions where demand does not exceed supply. As I will explore further in chapter 4, the Mexican government's water management regime has also undergone a neoliberal-era transformation (Wilder and Romero Lankao 2006), chiefly through an attempt to decentralize decision-making, and to diminish (or privatize) the once-robust state-driven "irrigation districts" program.

Water privatization, another general goal of most neoliberal economic reform packages Swyngedouw 2005, 2), is an often-misunderstood concept. Arguments over water "privatization" are usually, in fact, about how the construction and maintenance of *infrastructure* to transport water to users should be paid for (Bakker 2010a, 5), not arguments over the ownership of water *per se*, nor arguments over the ownership of the places where water happens to emerge from the earth. Most privatization disagreements arise over the transport infrastructure of water to urban users, especially domestic use among the urban poor. However, rural areas can be impacted by increasing commercialization of water provision to urban users, at least politically.

Neither water rights nor water privatization currently pertain directly to the present study, since the study regions are neither water-poor nor urban. This study will touch on both concepts from time to time, because in the future parts of both study regions are likely to become more intertwined with the water rights and urban service systems of Mexico.

1.1.7 Water sources, water conduits, and water storage

This study focuses on "water sources" – places where water is taken by humans, to be used at that place or transported to a user some distance away. The kinds of water uptakes include locations along a stream, shallow wells (to access ordinary flowing groundwater), deep wells (to access aquifers), or intakes at natural lakes or dammed reservoirs. This study concentrates on one specific type of source: the "spring." Springs (*manantiales* in Spanish), including the short stretches of stream just below them, have practical and symbolic values not shared with other surface sources: their water is generally cleaner, and often more reliable in dry seasons (Cairncross and Feachem 1993, 65).

The focus on the spring-land nexus will include responsibility for the care of the spring, including the tree and large shrub vegetation in its immediate vicinity, often deemed to be an important component of keeping the spring's water clean and plentiful.

A secondary focus for this study is the "water conduit"; that is, the conveyance infrastructure – the pipe, tube, or channel by which water is transported from the source to the use point. This, too, can raise questions of individual and communal management and ownership: Who builds the conduit? Who maintains it? Who is the end user? What is the agreement between them and the owner(s) of the land where the source is located?

Occasionally, a third physical feature will be considered: the water storage infrastructure. Some kind of storage, such as a reservoir or a tank, is necessary whenever water must be collected before it is distributed, either for engineering reasons (gravity, for example), or because it is to be used over a period of time (typically, during the dry season), or for both of these reasons, as is the case with most "municipal" (in the sense of "urban") potable water systems.

1.1.8 Indigenous peoples and the state

The term "indigenous" can mean many things, but one of its more consistently recognized aspects is its reference to groups of people which consider themselves to have occupied a certain territory (not necessarily the territory where they now reside) before the establishment of the state in which they now find themselves. Thus they have a special relationship with their national government: they are simultaneously a part of that state, and yet apart from it – and, in some cases, antagonistic to it (Niezen 2003, 20; Engle 2010, 95; Maybury-Lewis 1997, 8). This special relationship is perhaps more of a marker of indigeneity than the often-evoked concept of communal property. While village-scale self-identity and decision-making is certainly an important part of indigenous culture in Mexico, it is equally a part of much rural *non*-indigenous culture; and, as this study will demonstrate, the supposed indigenous preference for the community over the individual was never as overwhelming as many have supposed.

One way in which some indigenous people express their partial separation from the state is by linking natural resources (including water) to territory more firmly than the state does

(Kauffer Michel 2006, 226). Related to this is the deep attachment that some indigenous people have to the territories they most identify with (even if they do not currently occupy, or legally own, those territories). One must be careful to avoid implying that non-indigenous people cannot feel equally tied to a piece of land, or that indigenous individuals shouldn't be free to live wherever they want to. However, it is logical that indigenous individuals and groups, sharing a sense of temporal priority over the state, would include deep territorial links within their evolving struggle to define their relationship to the state, even (perhaps especially) in countries like Mexico where the legal concept of indigenous territory does not exist (Bonfil Batalla 1987). I will explore these links further in chapter 4.

1.2 Summary of study areas and methods

This study uses data from 35 study areas in two regions of Mexico: the Huasteca Potosina region[8] in the state of San Luis Potosí, and the Sierra Norte region (sometimes called the Sierra Juárez, for its most illustrious native son, the 19th-century indigenous president Benito Juárez) in the state of Oaxaca. Two of the study areas, one in each region, are large zones I call "geodata analysis areas." The boundaries of these areas were determined by the extent of INEGI 1:50,000-scale topographic sheets (four sheets in the Huasteca area, and seven in the more sparsely settled Oaxaca area), modified to exclude areas outside the states of San Luis Potosí and Oaxaca. While the spatial definitions of the "Huasteca Potosina region" and "Sierra Norte de Oaxaca region" vary in the literature, it can be said that each geodata analysis area encompasses about two-thirds of the region for which it is named.

The other 33 study areas are smaller territories contained within the geodata analysis areas. Each of these smaller areas ("RAN document study *núcleos*") consists of the entire territory of an *ejido* or *comunidad* that underwent archival research.

In 15 of the 33 RAN document study *núcleos*, I engaged in more intensive field-based research, at varying levels of intensity. I call these "PRM study *núcleos*," as full participatory

[8] The Huasteca is a larger cognitive or vernacular region without precise boundaries which includes portions of the states of Veracruz, Hidalgo, Tamaulipas, and San Luis Potosí (Ochoa 1989, 5). The "Huasteca Potosina" is the part within the state of San Luis Potosí state.

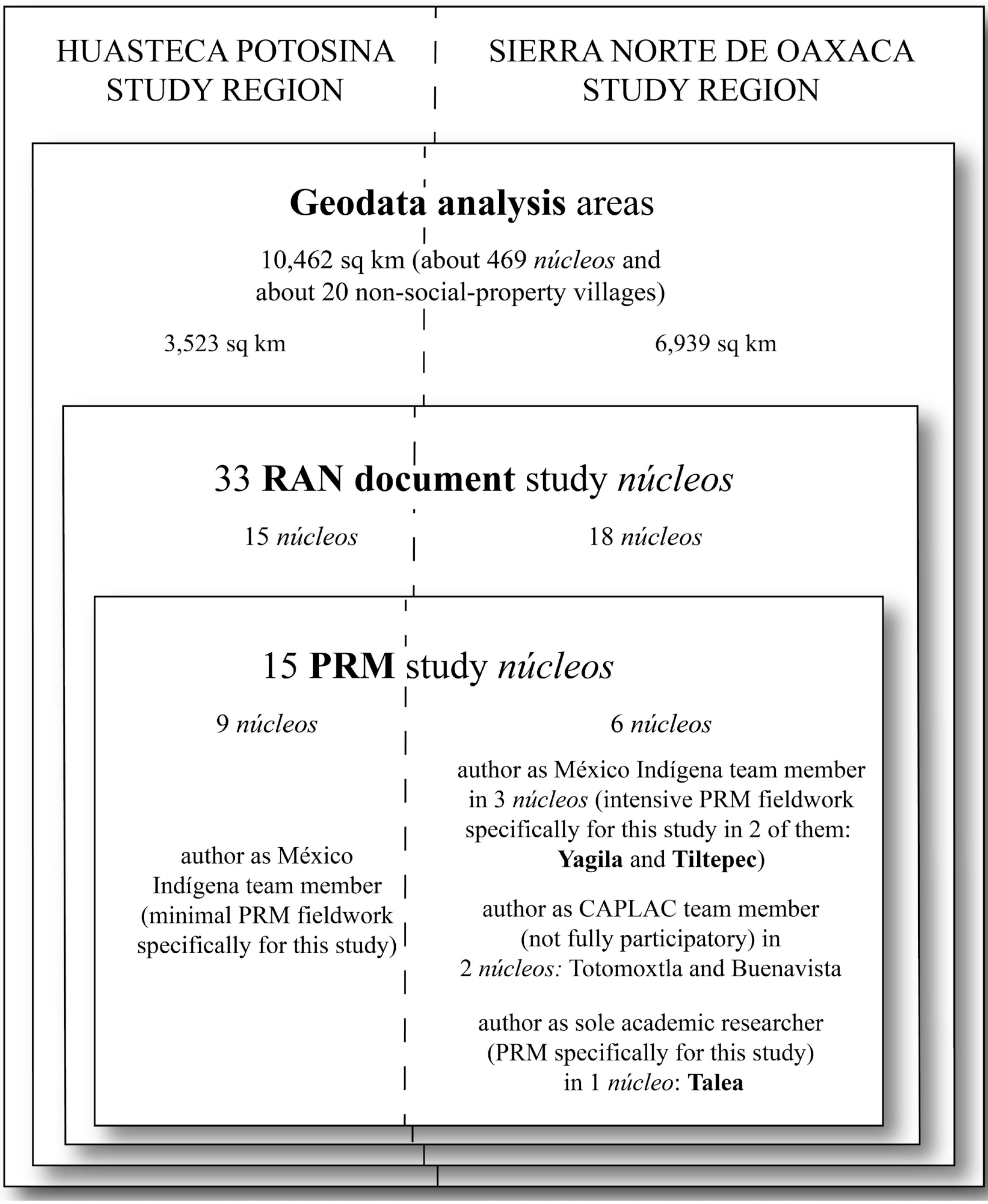
research mapping was carried out in all of them except two (Totomoxtla and Buenavista, where I executed partially participatory work in 2003 and 2004 as part of a rural development and conservation team called CAPLAC). In one of these 15 *núcleos*, Talea, I carried out PRM work in 2009 as the sole academic researcher, focusing on fieldwork specifically for this study. In the remaining 12 *núcleos*, I was an integral part of the México Indígena team's PRM work from 2005 to 2008. In two of these México Indígena PRM *núcleos*, Yagila and Tiltepec, I engaged in considerable fieldwork specifically for this study.

Figure 1.4 is a schematic diagram showing how the study areas and study regions are related to each other. Figure 1.5, on page 36, is the first of five maps which show the locations of the of the two study regions within Mexico (the polygons are the geodata analysis areas). Figure 2.1, on page 47, is the first of three maps which show the locations of the RAN document study *núcleos* in the Huasteca Potosina. Figure 2.4, on page 53, is the first of three maps which show the locations of the RAN document study *núcleos* in the Sierra Norte de Oaxaca.

The main purpose of the RAN archival document research was to understand the balance between village-scale and individual orientations toward land and water in indigenous *ejidos* and *comunidades* as it has evolved since the Mexican Revolution, and how these orientations have been negotiated with the state. The purpose of the PRM work was to document these orientations in more detail as they are practiced in the second decade since the 1992 neoliberal reforms. In the geodata analysis areas, the principal task was to compare the densities of important springs located in various social and non-social land tenure types. This analysis had two goals: to find whether certain tenure types possess a higher-than-average "natural endowment" of springs, and to ascertain whether some PROCEDE-parceled *núcleos* appear to be making efforts to keep these springs under village-scale control. The main tool for organizing and analyzing the PRM and geodata information was ArcGIS (versions 9.3 and 10.0), a GIS software platform developed by ESRI (Environmental Systems Research Institute).

In the next two sections I investigate the geographic extent of indigenous residents, social property, and high-rainfall zones beyond the study areas, to better determine where my observations might apply.

Figure 1.4. Study areas and principal methods (schematic diagram).



1.3 Constraints on the impact of long-distance water transport to cities

To better understand how water might become a more coveted resource in parts of Mexico, including perhaps in well-watered, indigenous-dominated regions, I researched examples and trends in transport of water from villages, including from social property *núcleos*, to other land tenure entities. I found that there are generally three circumstances which warrant the expensive investments necessary to move water more than a few kilometers, and each of these circumstances operates at a different scale. I concluded that highly engineered long-distance transport of water, important a subject as it may be, is unlikely to have much of a direct impact on my study areas, at least not in the foreseeable future.

The largest scale of water transport occurs when a large city engineers a system of dammed reservoirs, pumps, and aqueducts or canals to supplement its potable water service. Such a system covers a large area overall, typically over 10,000 sq km, but its water extraction directly impacts a much smaller total area. The handful of extraction points can affect a scattered assortment of rural places whose water sources may be mildly compromised, as well as a few communities whose land area is reduced when reservoirs are created after land is condemned via eminent domain. Less directly, the extraction zone can include a larger number of communities in the watersheds where permitted land uses may be restricted by hydrological and environmental authorities. In some countries, the opportunity costs caused by such restrictions are partly compensated through government-organized payments for environmental services (Daily and Ellison 2002, 63). Mexico City is the one of three metropoles in Mexico with a large system of long-distance water transport: the Cutzamala.[9] Intriguingly, its sources are in the Mazahua indigenous area. I will discuss their political and cultural protest movement against aspects of the Cutzamala system in subsection 1.3.1.

Medium-scale water transport occurs when a large town or growing city receives water from a specific water source (e.g., a reliable spring), often from a village territory typically about 10 km from the city's center, to augment or provide its potable water supply. There are perhaps several dozen examples of this throughout Mexico (e.g., Seefoo 2002), and there will be new

[9] The other two large-scale systems provide water to Guadalajara and Tijuana. Several additional cities have somewhat smaller systems which I categorize as "medium-scale transport" (Whiteford and Bernal 1996, 224).

ones in the future: "competition for water between rural and urban populations and governments has increased" (Whiteford and Bernal 1996, 224). Nonetheless, the potential locations for this sort of situation are limited. In subsection 1.3.2, I will focus on one example which has engendered village-scale tension, though in a non-indigenous-language area: the *ejido* of Axocopan, whose spring provides water to the city of Atlixco, in the state of Puebla.

The third scale of water transport out of a village occurs when water-intensive agriculture, sometimes run by a company for national or export commercial markets, uses water derived from a nearby place that may be within a social property *núcleo*. The potential locations for this arrangement are more widespread than those for village-to-city medium-scale transport, but are nevertheless limited to certain circumstances. This is the most likely of the three scenarios to affect some *ejidos* and *comunidades* within the geodata analysis areas.

The findings in this section draw from secondary sources, augmented by land tenure data I collected through the GAIA (INEGI 2011) and PHINA (RAN 2009-12) online datasets, and by indigenous language data in the INEGI census (INEGI 2010). I describe these sources in detail in chapter 3. For the localities described in this section, I also used GoogleEarth to help determine the location of major springs.

1.2.1 Mazahuas and Mexico City's Sistema Cutzamala

The Cutzamala surface water catchment and transport system, whose first phase was completed in 1982, provides 18 percent of the water used in a "service area" encompassing all of Mexico's Distrito Federal, including most of Mexico City, and part of the state of Mexico. This water volume represents two-thirds of the water imported into the service area. The rest of the metropolitan area's transported water originates as groundwater drawn through wells in the Río Lerma valley (SEMARNAT and CONAGUA 2009). The water comes from seven different reservoirs and their catchment areas that are 90 to 140 km west of Mexico City, most of them originally built in the 1950s for hydroelectric power. Two of the reservoirs are in the Valle de Bravo area of Mexico state near the Michoacán border, two others are in the high-altitude Río Tuzantla Valley in Michoacán, and three others (including the Presa Villa Victoria) are north of

Valle de Bravo in Mexico state. The first and second groups of reservoirs supply water to the third group by a series of pumps (Haddad 1991).

The catchment areas around several of these reservoirs are inhabited by the Mazahua, an indigenous group whose language belongs to the same branch of the Oto-Manguean family as the Pame of the Huasteca Potosina. To better understand the land tenure geography of the area, I took a closer look at one village, the *ejido* of San Diego Suchitepec, which borders one of the reservoirs. 24 percent of Suchitepec's residents speak Mazahua. The *núcleo* contains two large villages and 10 smaller ones. 750 ha had been expropriated by the federal electricity board in 1947, during planning for the reservoir. The *núcleo* was surveyed and certified by PROCEDE in 2006; of its 2,500 ha, 212 were assigned to common use, while the rest was divided into individual parcels (INEGI 2011; RAN 2009-12). Of the eight major springs, three are located within the common use areas, two are on individual parcels, and three are technically within the parceled area, but in fact within public "rights of way."

While the direct impact of the Cutzamala system on water and land in *núcleos* like Suchitepec is small, the symbolism of water originating in a relatively poor indigenous region to supply a partly wealthy metropolis 100 km away is real and strong. Environmental historian Donald Worster (1985, 5) described the socially alienating effect of large hydro-engineering projects thus:

> Quite simply, the modern canal, unlike a river, is not an ecosystem. It is simplified, abstracted Water, rigidly separated from the earth and firmly directed to raise food, fill pipes, and make money.

In 2005, angry that the state and federal governments were investing a great deal of money in the Cutzamala system while failing to improve village-scale water access in the source region, a group of Mazahua women formed an armed movement, mainly using Revolution-era old guns with handmade stocks (Cevallos 2006). Because they tend to use water in their daily routines, and were attempting to develop new orchards and domestic-use vegetable gardens, the women felt that their initiative would have special impact. They were particularly incensed that "37 percent of the potable water" in the Cutzamala system was lost through leakage (Gómez Fuentes 2009). In 2010, the Mazahua Front blocked the main highway to Toluca and reportedly closed a valve on a Cutzamala pipeline, demanding that then-governor (and current president) Enrique Peña Nieto fulfill his promise to have modern water systems installed in their villages (Agencia MVT 2010; Enciso 2010). In Mexico, where organization at the level of the specific indigenous ethnolinguistic group tends to be relatively weak (Yashar 1997, 9; Jung 2003, 19), it is interesting that the regional-scale Cutzamala water system did provoke an ethnia-scale political response (Kelly 2012, 296).

1.3.2 Axocopan's spring and the city of Atlixco

The village territory of Axocopan comprises 1,420 ha of social property (the *ejido* of La Magdalena Axocopan, surveyed by PROCEDE in 1998) and 580 ha of private property, a "*fondo legal*," purchased by local residents before the Revolution, and where the main town is located. Within the territory is an important three-part spring, two parts in the private property area and the third on one of the PROCEDE-surveyed parcels. It is located near headwaters of the great Río Balsas watershed (Wolf 1959, 9). Since 1939, the Axocopan spring has provided water to the residents of the city of Atlixco 4 km to its east, a city whose suburbs now include and surround parts of the town (Ramírez Júarez, Campos Cabral, and Campos Cabral 2006, 180).

The shared water history of the two communities is one of complex deals, resentments, and recriminations. "Atlixco violated its share repeatedly, leading to an April 2004 direct action by the *ejido*, blocking the passage of water toward the city" (Ramírez Júarez, Campos Cabral, and Campos Cabral 2006, 184). The two entities entered a new agreement by which 14.2 percent of the spring's water remains in Axocopan, while 9.5 percent is transported to Atlixco; the rest is destined for nearby commercial enterprises. However, the *ejido per se* does not actually receive the Axocopan portion; instead, its rights belong to the *fundo legal* – all the "people" of Axocopan, but without the protections associated with social property (even after PROCEDE). Some of this water is apportioned to a *sociedad* of fruit growers consisting of a minority of *ejidatarios* (Ramírez Júarez, Campos Cabral, and Campos Cabral 2006, 189).

While neither the land tenure nor the water rights pertaining to its spring are entirely village-oriented, nonetheless the residents of Axocopan have developed a sophisticated village- and sub-village-group-scale organizational mechanism for maintaining the spring and distributing the village's share of its water (Campos Cabral 2011, 29). Perhaps it is the struggle with the city of Atlixco which has promoted this village-scale unity in spite of the factors which run counter to it.

1.4 This study's applicability to other places

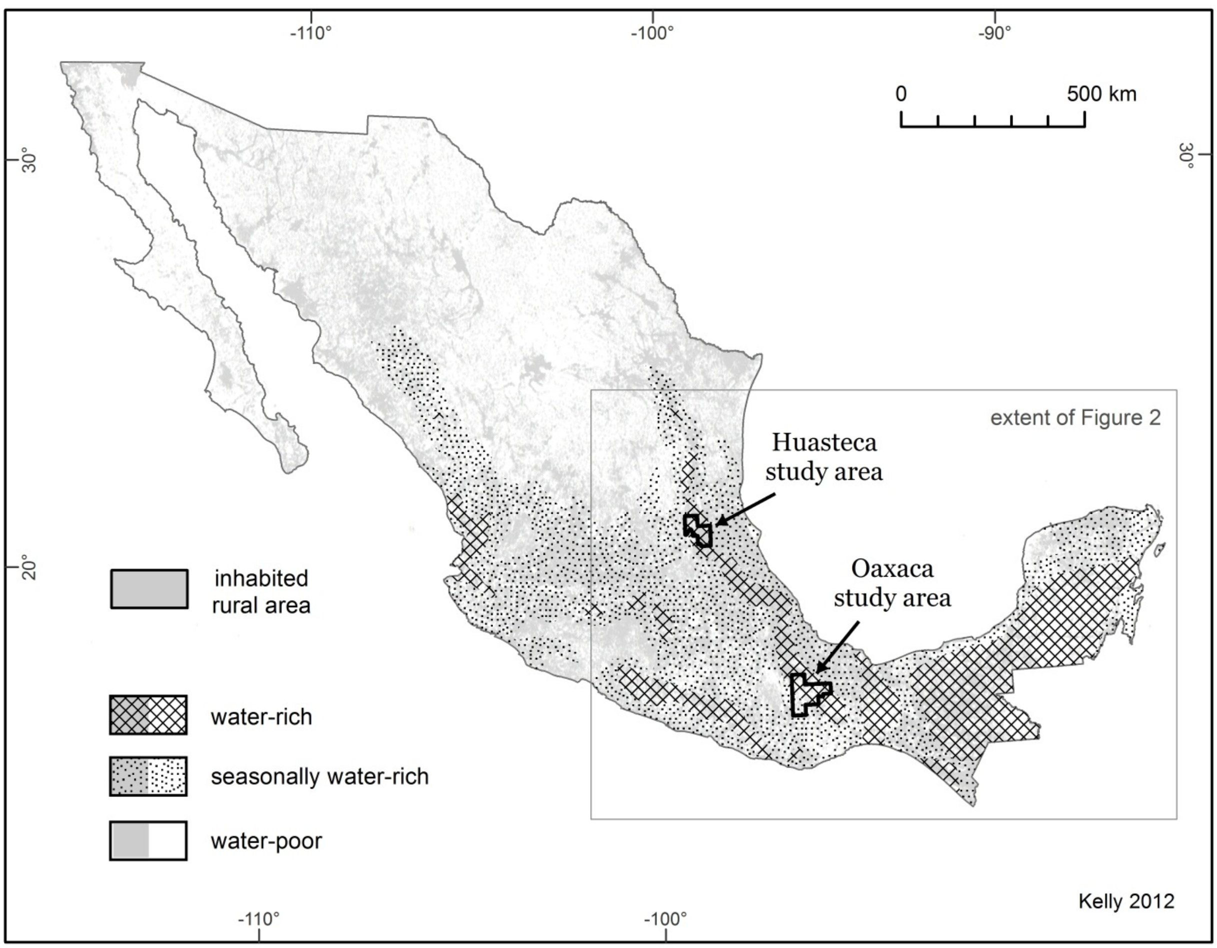
This study encompasses areas within two regions in Mexico (Figure 1.5): the "Huasteca Potosina," in the southeastern part of the state of San Luis Potosí, and the "Sierra Norte de Oaxaca," in the northern part of the state of Oaxaca. In this section I will discuss to what extent the study's findings may be generalized findings; in other words, how far beyond the boundaries of my study areas do the geographic characteristics vital to the hypothesis extend? (Besides the commonalities described here, the Huasteca and Oaxaca study regions also present illuminating contrasts which will discuss in chapter 2). I stress that while the "water source" is the main subject of this study, in a broader sense this geographic feature is only intended to serve as an example of the evolving relations among indigenous individuals, villages, and the state. Some of the findings of this study may apply to other geographic features and natural resources other than water, and also to certain countries beyond Mexico. These findings may therefore be applied beyond the zone which I delimit in this section.

1.4.1 Water-rich, indigenous, social-property-dominated regions of Mexico

Being within the geographic research tradition of cultural ecology, this study involves the spatially local links between humans and water sources. More specifically, this study is concerned with social property, which in Mexico was a system developed overwhelmingly in rural areas (although the expansion of some metropolitan areas into *ejidos* has engendered issues not examined here). Therefore, the "first cut" in narrowing the area of applicability is to identify rural, but inhabited, places in Mexico (Figure 1.5), which I did by displaying all the *localidades* (rural census tract points) in the 2005 national census (INEGI 2005b). Each point represents a rural population center, as large as a town of 2,000 inhabitants or as small as an isolated farmhouse with two inhabitants. When displayed at this national scale, the dots appear as a gray pattern, continuous in some places and disjunct or web-like in others. The true desert areas of Coahuila state, the Pinacate-Altar region of Sonora, and the Baja Peninsula are visibly less densely inhabited, as are the three remaining tropical forest frontiers (internal colonization fronts) of Chimalapas (the southern half of the Isthmus of Tehuantepec), the Lacandon region of Chiapas state, and the Calakmul region of Campeche state.

Rainfall patterns in Mexico are complex at both regional and local scales (West and Augelli 1989, 38), but can be simplified to three major classes: "water-rich" areas (where the

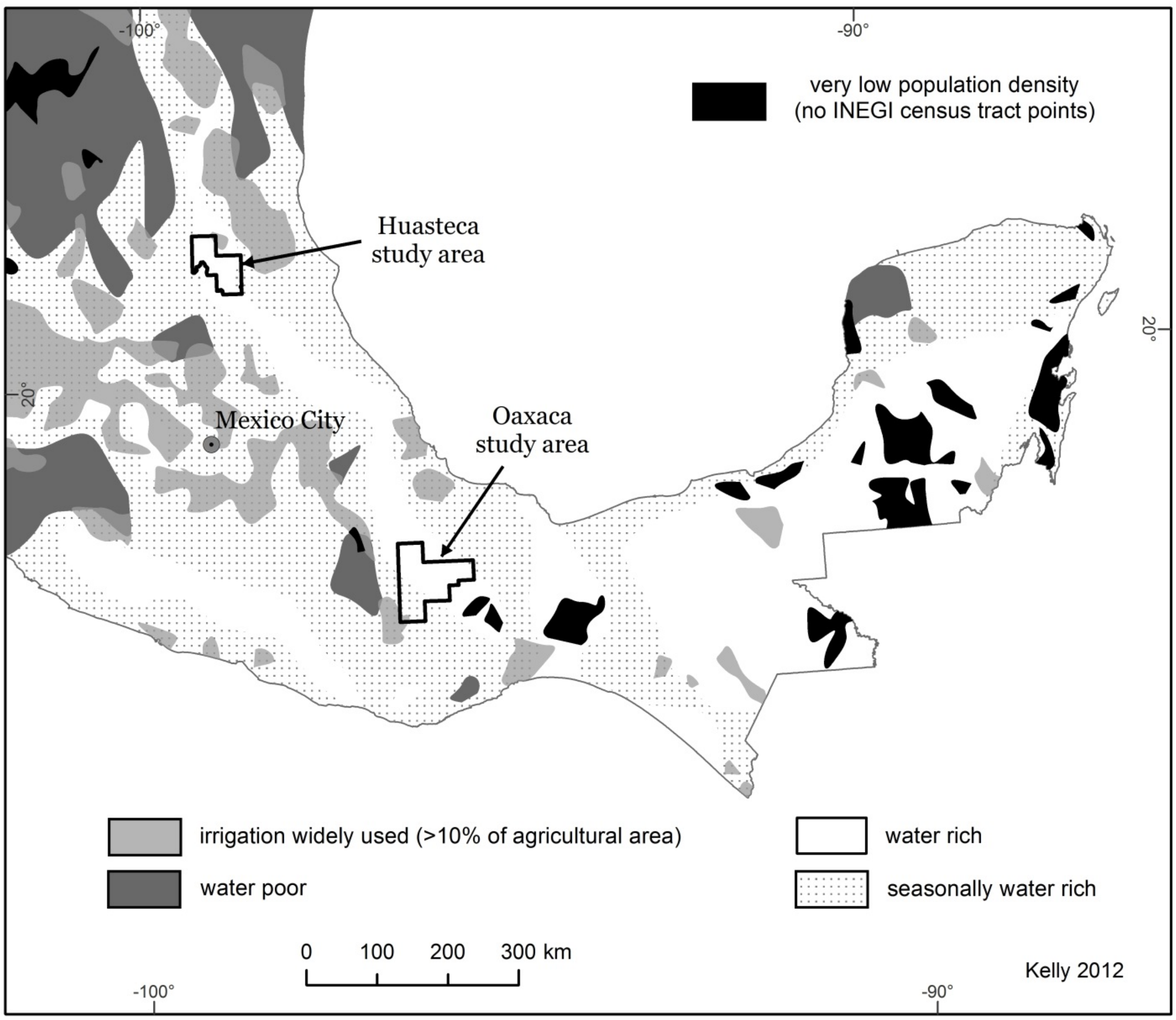
Figure 1.5. Mexico: Inhabited rural areas, and areas with relatively high year-round or seasonal rainfall (Sources: INEGI 2005b; Sheffield, Wood, and Munoz-Arriola 2010).



winter dry season is shorter than about four months, and/or rainstorms are relatively frequent even in the dry season); "seasonally water-rich" areas (where the contrast between the dry and rainy seasons is especially pronounced, corresponding to the approximate extent of Köppen potential vegetation type "Aw"); and "water-poor" areas, generally where subtropical high pressure dominates over trade wind patterns for most of the year, as well as a few orographic rain-shadow zones further south (Sauer and Brand 1932, 59). I based the distribution of the areas in Figure 1.5 on a map showing "a high resolution (~ 10km) dataset of evapotranspiration for Mexico for 1984-2006 based on remote sensing data" (Sheffield, J., E. F. Wood, and F. Munoz-Arriola, 2010, 271). My water-rich areas correspond to an average evaporation rate of more than 2.0 millimeters per day, while my water-poor areas correspond to a rate of less than 1.0 millimeters per day. The familiar wet and dry areas of Mexico are well illustrated, from the most general pattern of "north=dry, south=wet," to regional-scale patterns such as the orographic rainfall belt along the Sierra Madre Oriental (including its extension as the Sierra Norte of Oaxaca). The principal effect of these patterns on agricultural potential is that "water poor" places generally require irrigation for any crops other than subsistence *milpa* (the traditional corn-beans-squash complex), while some "seasonally water rich" places will also require irrigation for certain crops.

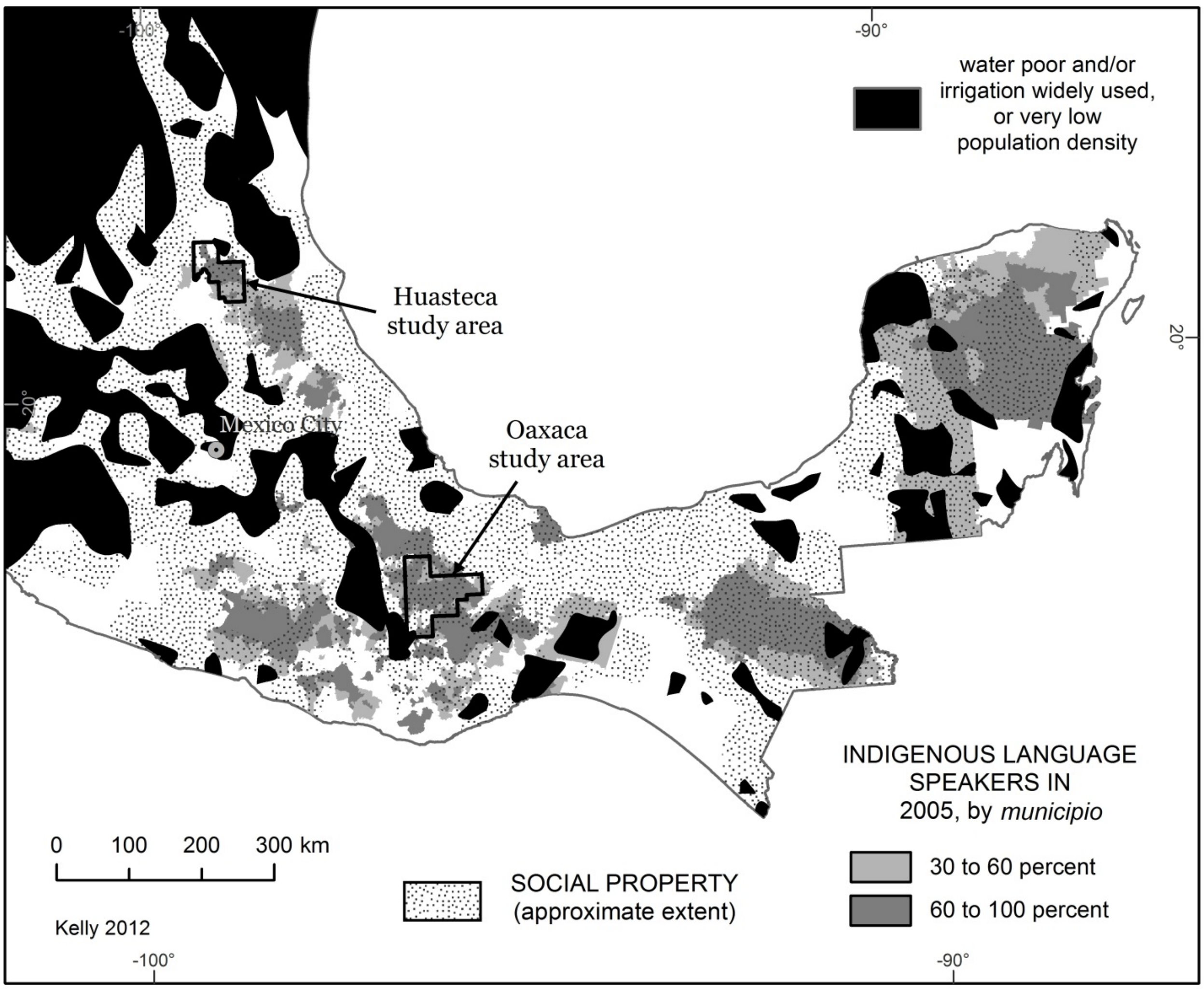
To better define the areas where local formal systems of water allocation rights are probably uncommon, I produced a second map (Figure 1.6) which shows only southern Mexico. In this map, the three wetness classes – "water rich," "seasonally water rich," and "water poor" – are repeated from the first map, except that now they are shown so that the areas which most closely resemble the study regions (that is, mainly "water rich," and a few areas of "seasonally water rich") are shown in white or light gray stipple. In this map, a new variable, *irrigation*, enhances our understanding. Areas with more than 10 percent of farmland "equipped for irrigation" around the year 2000 (though not necessarily irrigated), according to a map republished by the FAO (Siebert et al. 2007), are shown in gray. Most of these are within the "seasonally water rich" zones, including two areas near the Oaxaca geodata analysis area (part of the Central Valley to the southwest, and part of the Tehuacan Valley to the northwest), and one large area near the Huasteca geodata analysis area (the Gulf plain to the northeast, centered on where the states of Tamaulipas, Veracruz, and San Luis Potosí meet). If climate change causes a local decrease in rainfall, and/or if economic incentives cause a local increase in highly irrigated export crops, places adjacent to these areas may be most likely to develop locally accepted water allocation systems where none traditionally existed.

Figure 1.6. Southern Mexico: Inhabited rural areas with relatively high year-round or seasonal rainfall; and, areas with more than 10 percent farmland equipped for irrigation in 2000 (Sources: Sheffield, Wood, and Munoz-Arriola 2010; Siebert et al. 2007).



The third and final map of the extent of the study's most direct applicability introduces two new variables: social property and indigeneity (Figure 1.6). (The areas in Figure 1.6 which are either "water poor," or ">10 percent agricultural area irrigated," or both, are shown in black in Figure 1.7, as these areas do not pertain directly to this study).

Figure 1.7. Southern Mexico: *Municipios* dominated by social property (*ejidos* and *comunidades*), and *municipios* dominated by speakers of indigenous languages (Sources: INEGI 2005b; INEGI 2006a; INEGI 2006b).



The full extent of social property in Mexico is surprisingly difficult to map. Figure 1.7 presents a reasonable approximation of social property at the *municipio* scale. I produced this coverage in ArcGIS by first joining the table of total *núcleos* in each county who had completed some degree of PROCEDE survey work by 2006 (INEGI 2006b) to the 2005 INEGI county shapefile. I created a field for the count of *localidades* within each county, and a final field of the ratio of PROCEDE *núcleos* to this count. There are three potential sources of inaccuracy: *localidades* are not a perfect proxy for "*núcleos* and non-social-property villages"; the PROCEDE table does not include the approximately 7 percent of social property villages which had not done any PROCEDE surveying; and some *municipios* with large areas may be only partly dominated by social property.

I mapped indigenous areas by *municipio*, using the proxy variable "population 5 years or older who speak an indigenous languages" (INEGI 2006a), by calculating the ratio of this variable to "total population 5 years or older."

To the extent that this study focuses specifically on *indigenous* water-rich areas of Mexico, the region of greatest applicability appears as both gray and stippled in Figure 1.6. The notable regions include the rest of the upland (western) Huasteca region extending southeast of the study region, into Hidalgo and Veracruz states; a few smaller parts of Oaxaca state, including part of the Mixe-speaking area; most of the Chiapas Highlands, especially in the northern half of that state; and an extensive area shared by the states of Yucatan and Quintana Roo.

More broadly, the current study pertains to water-rich social properties of all ethnic types, indigenous and otherwise. As depicted in Figure 1.7, this enlarges the zone of applicability to include most of Veracruz state, significant parts of Guerrero state, and smaller areas within other states, including the "*Zona Media*" region of San Luis Potosí state, west of the Huasteca region.

1.4.2 Current trends impacting the study areas as potentially important sources of water

In section 1.3 I explained why only a restricted number of places in well-watered regions of Mexico currently serve as important sources of medium- and long-distance engineered water transport. In this sub-section I consider the possibility that climate change or other factors could increase the number of such places.

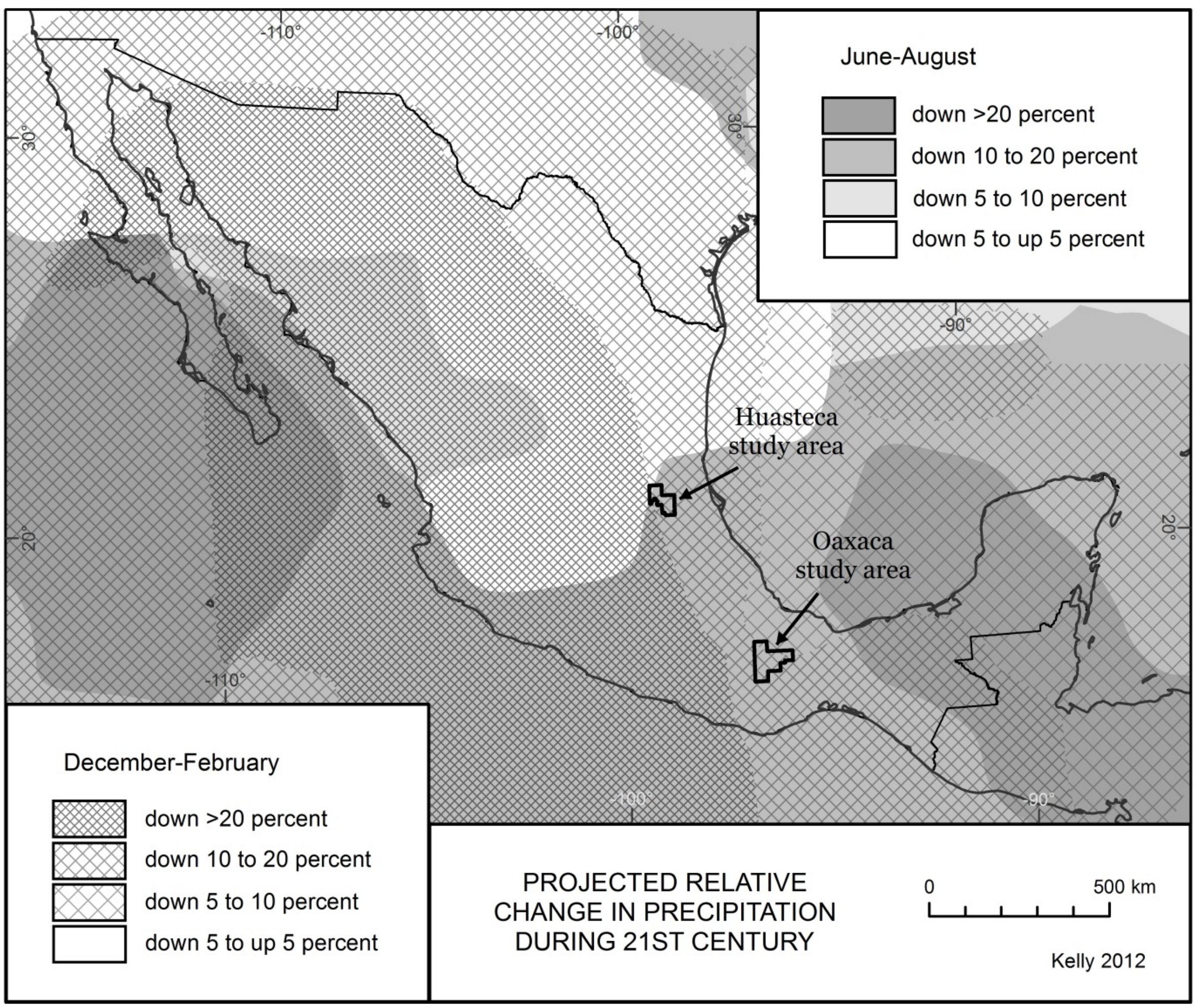
Three factors could increase the value of water in the study areas, especially in when combined: decreased rainfall in nearby areas, high population growth in nearby cities, and a steep increase in water-intensive export agriculture or rural industry (e.g., a commercial distillery) in a village or one near it. (A fourth possible factor, greater demand for commercial bottled water from clean mountain springs, would have only scattered and localized impacts.[10])

Figures 1.8 and 1.9 show how three recent, well-regarded studies predict that global climate change will affect the regional availability of water. "Projections for changes in precipitation patterns are extremely complex, involving a high degree of uncertainty and large heterogeneity" (IPCC 2007); furthermore, the SEMARNAT/CONAGUA water stress prediction takes into account expected change in human demand and consumption, not just climate change. These uncertainties are reflected in the maps: while IPCC and Arnell agree that southern Mexico (particularly Yucatan and northern Chiapas) will probably experience a sharp decrease in water availability, especially in summer months, there are also disagreements among the studies. IPCC specifies that the entire Sierra Madre Occidental and Mesa Central regions will suffer the greatest decrease in winter precipitation, while SEMARNAT/CONAGUA predict that the border states of northern Mexico will experience a greater increase in water stress than elsewhere. The overall impression is that much of relatively wet southern Mexico will see a steeper decline in rainfall, but that relatively dry northern Mexico will undergo greater water stress due to factors other than rainfall, such as dependence on aquifers, higher population growth, and more widespread export agriculture. According to this, the Huasteca Potosina and Sierra Norte de Oaxaca regions fall somewhere in the middle of these extremes. Some contend that, overall, social property farmers are more likely to suffer crop failures than private property farmers (Liverman 1990, 66).

[10] Not considered here is a factor which essentially increases the value of naturally transported clean water: payments for environmental services (PESs) granted from the state to private or social property landowners for their willingness to conserve forest vegetation in watersheds where clean, abundant water downstream is regarded as important. I review this subject in chapter 4.

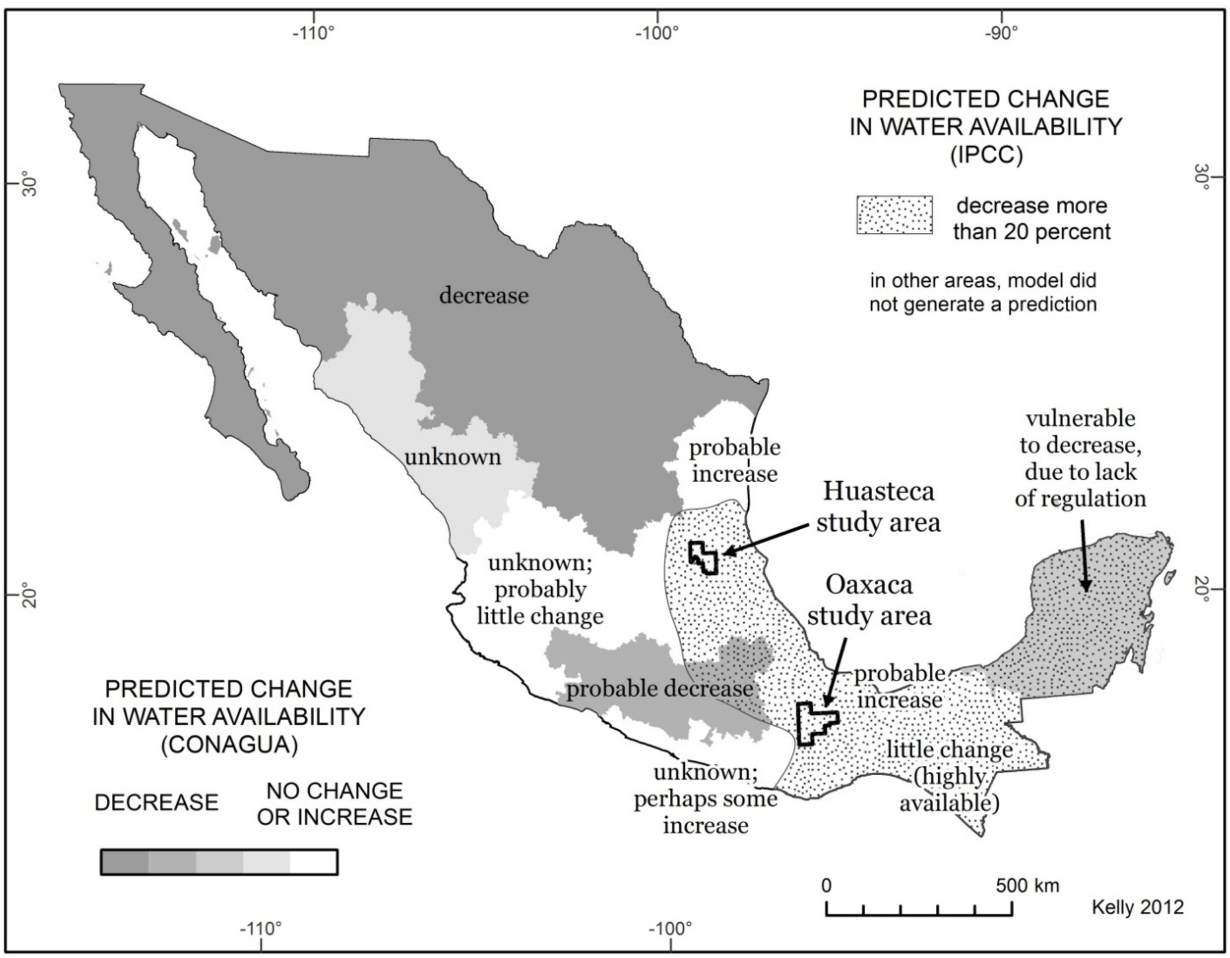
The growth of urban areas within or near the study areas is unlikely to be an important factor in regional water demand, but it could affect a few *núcleos*. Four cities are within 100 km of the geodata analysis areas, and downhill from part of them: Oaxaca city (10 km southeast of the Oaxaca area); Tuxtepec, Oaxaca (20 km north of it); Ciudad Valles (within the Huasteca area); and Tampico, Tamaulipas (100 km east of it). Oaxaca is the largest of these, with almost 600,000 inhabitants in 2010; it is followed by Tampico, with about 300,000; then Ciudad Valles,

Figure 1.8. Mexico: Projected relative changes in precipitation during period 2090-2099 compared to 1980-1999, according to SRES (Special Report on Emissions Scenarios) scenario A1B (adapted from IPCC 2007).



with about 170,000; and Tuxtepec, with about 100,000. Between 2005 and 2010, Oaxaca and Ciudad Valles experienced high population growth (9.2 percent and 6.9 percent, respectively), while Tuxtepec's growth rate was modest (1.3 percent), and Tampico's population actually declined, by 2.1 percent (INEGI 2010). It is conceivable, then, that a handful of *núcleos* in the

Figure 1.9. Mexico: Predicted change in water availability by CONAGUA administrative region, and according to IPCC scenario A1 (2050 as percentage of period 1961-1990). (Adapted from SEMARNAT 2007 and Arnell 2004).



northern extreme of the Huasteca geodata analysis area, and/or the southern extreme of the Oaxaca one,[11] could face an urban demand for their water akin to what Axocopa experienced (section 1.2).

The growth of water-intensive export agriculture in and around the study areas is not easy to predict, and in any case will never be as important a demand on local water supplies as it increasingly is in drier (and more U.S.-proximate) northern Mexico. It is potentially an important enough factor to merit some examination: observations on Mexican export agriculture trends in general, followed by an overview of water-intensive crops specific to the study areas. For the first ten years after the signing of the North American Free Trade Agreement (NAFTA) in 1993, Mexican agricultural exports to the United States more than doubled, while yearly increases have been more modest since 2003 (Villareal 2010, 13; Wilder and Whiteford 2006, 353). Vegetables and fruits whose exports have increased the most are sweet peppers, cauliflower/broccoli, carrots/turnips, lemons/limes, and watermelons (Yuñez Naude and Taylor 2006, 174). Export agriculture has been most intense in irrigated zones of northern Mexico such as Torreon (in Coahuila state) and parts of Sinaloa state. Of the aforementioned crops, only lemons/limes require intense water use, and are thus more commonly grown in high-rainfall areas such as the Gulf Coastal Plain.

The following account combines recent data from Mekonnen and Hoekstra (2010, 17-20) on water demand of different crops, Yuñez Naude and Taylor (2006, 178) on annual average production of Mexico's major exported vegetable and fruits, and INAFED (2007) on the important agricultural products of study area *municipios.*

Sugar cane, coffee, and rice are products which are medium-high to high water demanding, and grown in the study areas, but are not increasingly significant Mexican exports.

---

[11] In the Central Valley around Oaxaca City, irrigation from Río Atoyac and Río Salado floodwaters – barriers built to curb overland flow – are supplemented by shallow wells and rain-fed farming. "The history of water use in the Central Valley is one of increasing abstraction [i.e., extraction] at the outer edge of the drainage network leading to a decrease in water availability downstream in the Atoyac itself. More and more water has been taken from the perennial tributaries at their points of entry into the valley. Water has been used upstream of Oaxaca City in the Etla Valley by increasing the use of the high water-table zone and extending and modernizing canal systems. Abstraction has been multiplied many times over by the increasing number of wells with mechanical pumps, to the point that groundwater reserves are threatened" (Clarke 2000, 94).

Avocados, oranges, and pineapples are products which are grown in the study areas, and are increasingly significant Mexican exports, but which have only low to moderate water demands.

The only agricultural products which meet all three criteria – medium-high to high water demand, grown in significant quantities within or near the study areas, and increasingly significant as an export crop – are mangos and lemons/limes.[12] In the Huasteca Potosina, the commercial mango crop centers on Coxcatlán, between Tancanhuitz and Axtla de Terrazas (in Figure 2.2, on page 49). In the lowlands bordering the Sierra Norte de Oaxaca, the lime crop is concentrated around Jacatepec, about 15 km northeast of Valle Nacional, and around Choapam (in Figure 2.5, on page 56), while mango is grown most intensively around Choapam, as well as around Jocotepec, just 5 km from the RAN document study *núcleo* of San Miguel Lachixola. These portions of the geodata analysis areas have the greatest potential as future importers of medium-scale water transport using sources located within certain *núcleo* territories considered in this study.

[12] Just beyond the Oaxaca study area, the county of Valle Nacional was, during the Porfiriato era, notorious for the indentured servitude on its tobacco plantations (Turner 1909-1923). Tobacco is another high-water-demand crop, with moderate export growth potential; however, in the study areas, the quantity grown is a fraction of that of a century ago.

2. Study areas

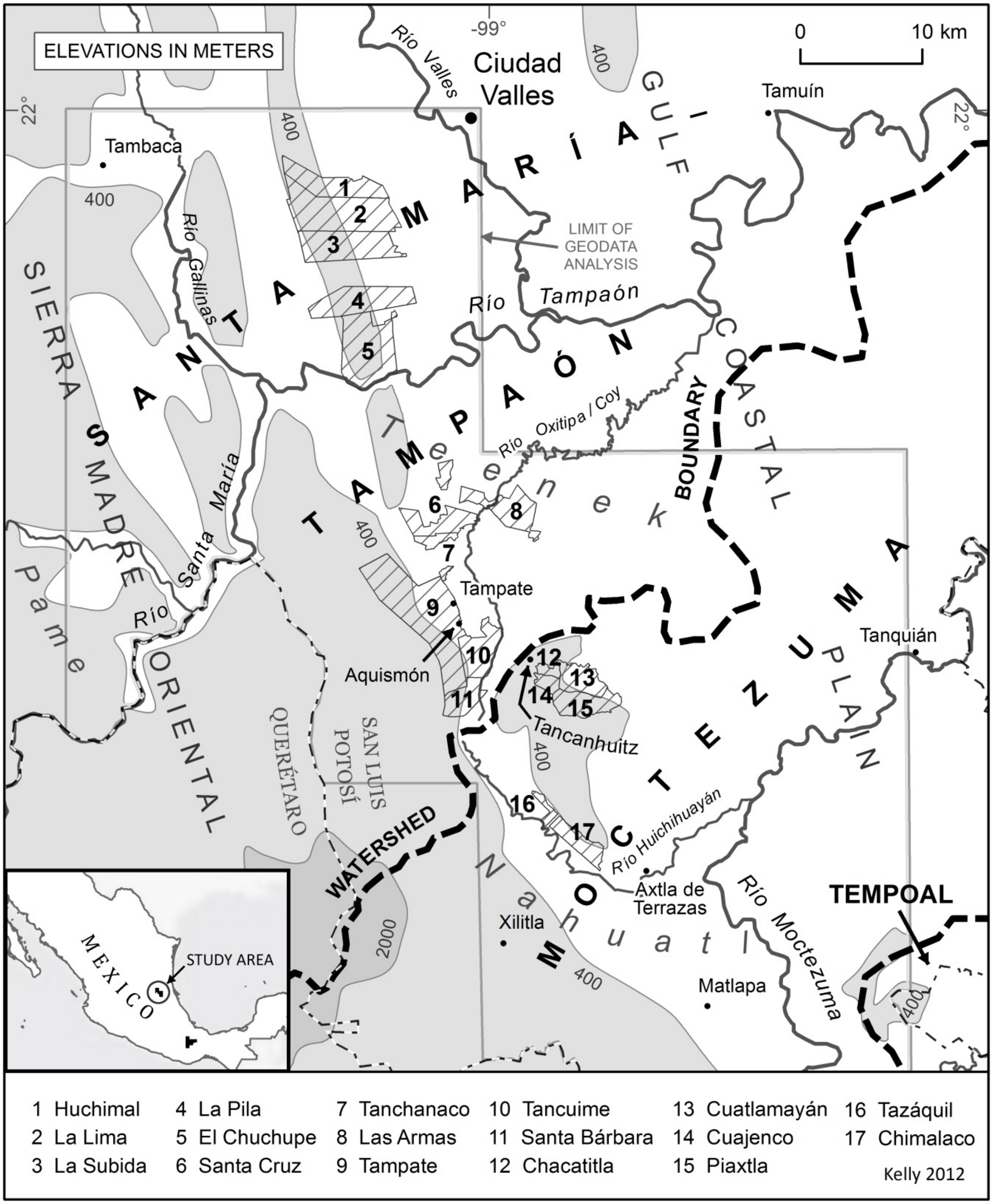
2.1 Huasteca Potosina geodata analysis area

2.1.1 Topography and hydrology

The Huasteca Potosina study region (Figure 2.1) is located along the boundary where the flat to gently undulating Gulf Coastal Plain, which continues into Veracruz state to the Gulf of Mexico (100 km east of the geodata analysis area), meets the Sierra Madre Oriental, a series of linear late Cretaceous limestone ridges that rarely exceed 800 meters in elevation. To the southwest into Querétaro state, these ridges grade into more imposing mountains, including the 2500-meter-elevation Sierra de Xilitla, which is composed mainly late Jurassic to early Cretaceous mudstone and shale. At the junction of the Gulf Coastal Plain and the Sierra Madre Oriental lie the Eocene sandstones of the Chincontepec formation. In some sections the sandstone is hidden or eroded, while in other sections it appears as jumbled low hills extending about 20 km eastward into the plain; the Sierra de Tancanhuitz is one of these hilly areas (Cossey 2011, 270; Suter 1980, 20-23).

The entire Huasteca Potosina geodata analysis area is within the super-watershed of the Río Pánuco,“the fourth largest river in Mexico by volume of runoff, and the sixth largest river basin in Mexico by area” (Arbingast 1975). This river is only called the Pánuco along its final approach to the Gulf, the site of Mexico’s first oil boom in 1911 (Brown 1993, 114). Further upstream, the river’s two principal tributaries are the Río Santa María-Tampaón and the Río Moctezuma. About two-thirds of the geodata analysis area is within the Santa María-Tampaón watershed, and the rest within the Moctezuma watershed. A tiny portion is in the watershed of the Tempoal, the third principal tributary of the Pánuco. Maps show the sources of these three major tributaries as far to the southwest, in the Mesa Central (high central plateau) of Mexico. The upper Río Moctezuma, for example, drains a northern portion of the Mexico City metropolitan area (Wolf 1959, 6). Due in part to the porous nature of limestone, several smaller but regionally important tributaries arise or re-emerge at the Sierra Madre/Gulf Coast boundary, including two within the study area: the Río Oxitipa-Coy and the Río Huichihuayán.

Figure 2.1. Huasteca Potosina study region: Watersheds, rivers, and topography. Numbers indicate RAN document study *núcleos*. Teenek, Nahuatl, and Pame language areas labeled in gray. (Topography adapted from INEGI 2000).



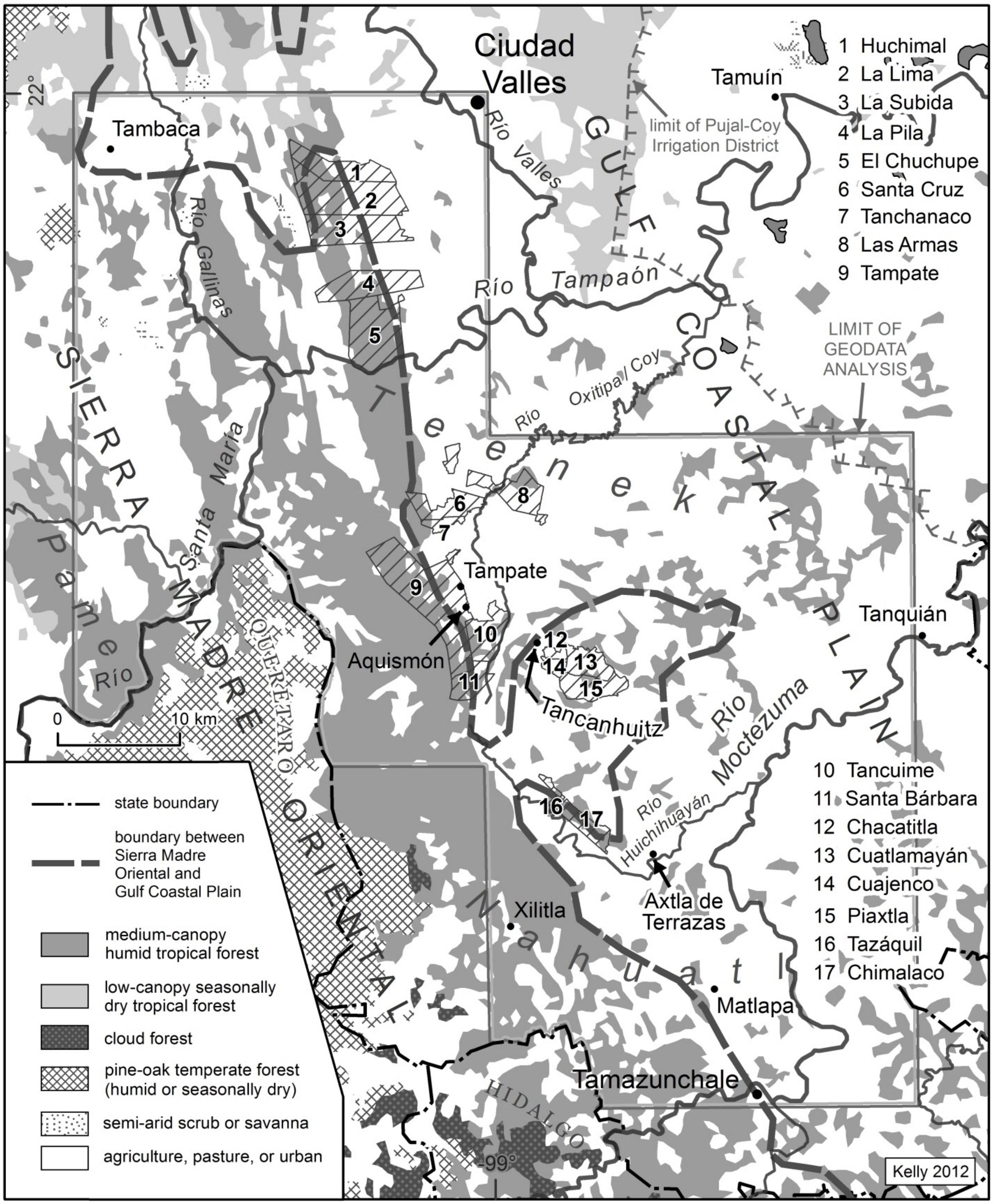
2.1.2 Vegetation and land use

The original and potential vegetation of the Huasteca geodata analysis area (Figure 2.2) includes several tropical forest types near their northern extremes of their ranges in the Americas. *Selva mediana subperrenifolia*, medium-canopy humid tropical forest with some dry-season deciduous trees, is found in much of the Gulf Coastal Plain and limestone ranges. *Selva baja caducifolia*, low-canopy tropical forest dominated by dry-season deciduous trees, is found in the northern and western extremes of the study area. *Bosque mesófilo de montaña*, cloud forest (a blend of tropical and temperate species, many endemic), is located in a small area where the Sierra Xilitla generates orographic rainfall.

I developed Figure 2.2 by starting with a 1:1 million-scale national shapefile of 28 vegetation classes created by the Mexican federal biodiversity research and policy organization (CONABIO 1999). From my fieldwork, I knew that this coverage understated anthropogenic disturbance, so I modified the coverage by georeferencing current GoogleEarth true-color (visible spectrum) air photography at 1:100,000 scale, and using it to identify patches which were discernible as agriculture.

The map shows a high degree of human alteration, especially in the Gulf Coastal Plain, where agriculture – particularly cattle ranching, but also extensive sugarcane cultivation (Tucker 2000, 28) – has eliminated most of the humid tropical forest. Large forest patches are now mainly restricted to the rocky soils and steeper slopes of the Sierra Madre Oriental. It should be noted that the distinction between “forest” and “anthropogenic land use” is often vague. For example, some continuous-canopy forested areas are better described as complex orchards, including the traditional *te’lom* system still practiced by some indigenous landowners (Alcorn 1983), and others are secondary forest mosaics with isolated temporary agricultural plots.

Figure 2.2. Huasteca Potosina study region: Land use and land cover, 2010. Teenek, Nahuatl, and Pame language areas labeled in gray. Numbers indicate RAN document study *núcleos*. (Vegetation adapted from CONABIO 1999).



2.1.3 Indigenous and *mestizo* populations

I created the map of indigenous and non-indigenous (*mestizo*) language speakers and of specific language areas (Figure 2.3) from 2005 census data using methods described in section 3.5. I present the raw population totals in chapter 7.

The map shows two indigenous core areas. The first is a large area of Teenek and Nahuatl speakers occupying the westernmost strip of the Gulf Coastal Plain, the low sandstone hills of the Chincontepec formation, and the first ranges of the Sierra Madre Oriental. Within this continuous zone, the spatial division between the Teenek area to the north and the Nahua[13] area to the south is quite sharp, with only a few small areas of overlap. Considering how the two groups share most culture traits, and that the dividing line does not correspond to a major physical barrier but rather cuts across the low hills of the Sierra Tancanhuitz, the clarity of the spatial differentiation surprised me.

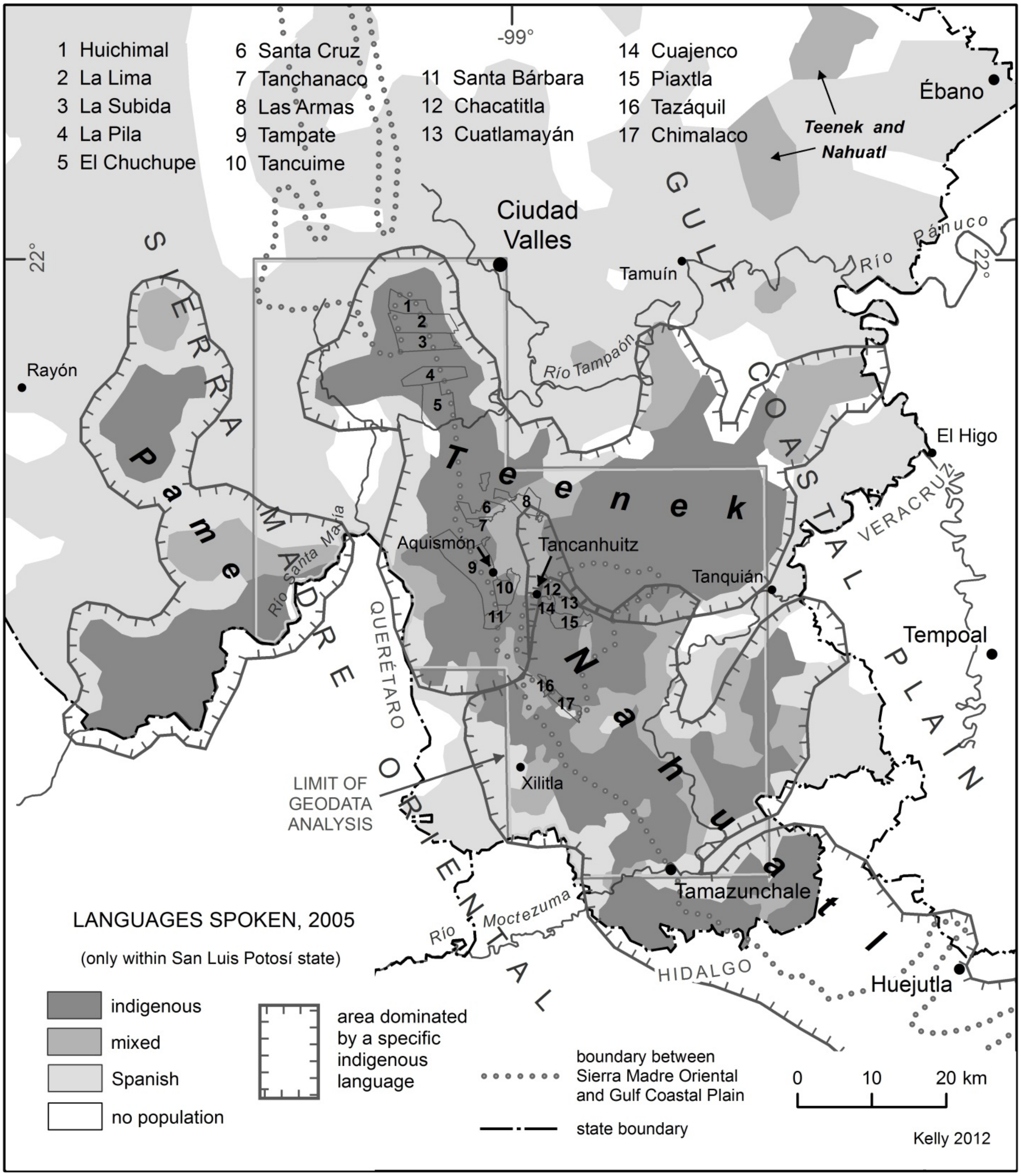
The Teenek, sometimes known as the "Huasteco," speak a geographically isolated language within the Maya family. Before the arrival of the Nahuas around 1458[14] and the later encroachment of the colonial Spanish, the Teenek probably occupied most or all of the vernacular "Huasteca region." The Nahuas speak a descendant variant of the Uto-Aztecan language of their Mexica forebears. The Nahuatl-speaking region which begins within the study area continues southward and southeastward another 80 km, and is not contiguous with the largest Nahua area of "central dialects" in the states surrounding Mexico City (Lastra 1986).

The second cohesive indigenous language zone in the geodata analysis area is occupied by Pame speakers deeper within the rugged Sierra. Pame is the northernmost of the Oto-Manguean languages, most of which are spoken in Oaxaca state, including Zapotec and Chinantec. Its closest linguistic relative is Otomí, spoken mainly in the state of Querétaro. The Pame-speaking zone once continued well into the mountains of Querétaro south of the Río Santa María, in an area known as the Sierra Gorda, but it is only spoken in a few villages there today (Gómez Rendón 2008, 231).

[13] "Nahua" is the ethnic group's demonym, and "Nahuatl" is their language.

[14] Additionally, the Toltec residents who settled in parts of the Huasteca in the 9th century may have spoken a variant of Nahuatl (Kaufman 1976, 115).

Figure 2.3. Huasteca Potosina study region: Indigenous, mixed, and *mestizo* population areas; and, specific indigenous language areas. Numbers indicate RAN document study *núcleos*. (Sources: INEGI 2005b; INEGI 2006a).



These indigenous language areas are surrounded by speakers only of Spanish, some of whom may self-identify as indigenous or practice indigenous culture traits besides language. The Within the geodata analysis area, these rural *mestizos* occupy the rest of the Gulf Coastal Plain, as well as much of the Sierra Madre Oriental beyond the Teenek, Nahua, and Pame cultural core areas. The one large city in the study area, Ciudad Valles, is majority *mestizo*, while the towns of Tamazunchale and Xilitla are about evenly mixed. The largest towns with a majority of indigenous speakers are Tancanhuitz and Aquismón.

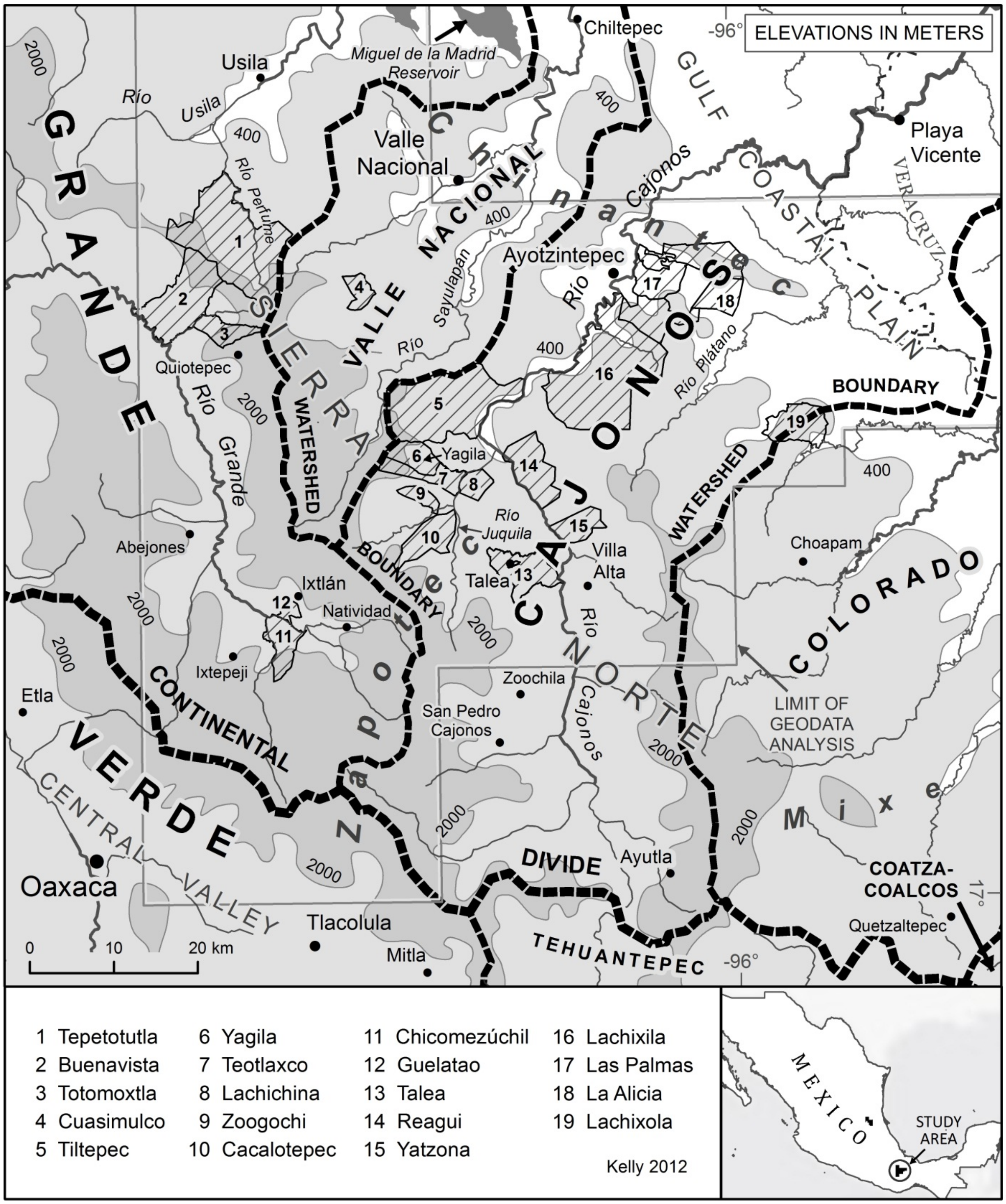
2.2 Sierra Norte de Oaxaca geodata analysis area

2.2.1 Topography and hydrology

The Sierra Norte de Oaxaca study region (Figure 2.4), 300-400 km southwest of the Huasteca Potosina, is crossed by the same boundary between the Gulf Coastal Plain and the mountains, which here are known as the Sierra Norte (or sometimes as the Sierra Juárez). In both regions, the state of Veracruz lies between the study area and the Gulf of Mexico. As in the Huasteca, the first low, linear ridges of the Sierra are late Cretaceous limestone, but these soon merge[15] into more geologically complex and higher-elevation mountains toward the southwest – in Oaxaca, mainly Permian schists and, southwest of Ixtlán and Ayutla and into the Central Valley, Paleocene andesitic tuffs (SGM 2000). The Oaxaca geodata analysis area includes a much smaller section of the Gulf Coastal Plain than the Huasteca one, and a much larger expanse of mountains, which surpass 3000 meters in elevation in several places. The area also includes a small part of the Central Valley, an approximately 1600-meter-elevation, mostly flat, T-shaped plateau centered on the state capital city of Oaxaca. This valley was created during and after the Miocene era, when the horsts of the adjacent Sierra Norte were raised along a normal fault, as a response to the southerly movement of the Chortis terrane under the Pacific Ocean (Centeno-García 2004, 37).

[15] One Sierra Norte water-formed feature is of global importance for speleologists, but does not impinge on the present study: the second deepest cave complex in the world (Tabor 2010, 32). It is located under the areas labeled “Mazatec” and “Cuicatec” in Figure 2.6.

Figure 2.4. Sierra Norte de Oaxaca study region: Watersheds, rivers, and topography. Numbers indicate RAN document study *núcleos*. Zapotec, Chinantec, and Mixe language areas labeled in gray. (Topography adapted from INEGI 2000).



The vast majority of the Oaxaca geodata analysis area, like the entire Huasteca one, drains into the Gulf of Mexico. The exception is the southeast corner of the Oaxaca area, in the Central Valley, which drains into the Pacific via the Río Atoyac/Río Verde. Like the Huasteca area, the Oaxaca one lies within a nationally important super-watershed – in the case of Oaxaca, the Papaolapan River basin. This super-watershed was famous as the location of a vast federal hydroelectric, irrigation, flood control, and rural development project mostly active in the 1950s and 1960s, modeled after the Tennessee Valley Authority (Gerencia Operativa 2011). Of the five major watersheds within the Papaloapan basin, parts of four are included within the study area: the Grande (called the Santo Domingo further downstream, after joining the Salado River which drains southeastern Puebla state); the Cajonos (called the Playa Vicente and the Tesechoacán further downstream[16]); the Colorado (also called the San Juan); and the Valle Nacional. Every decade or so, torrential rains cause floods and landslides in the Sierra Norte, threatening life and property (Pérez García 1996a, 64).

Twelve of the RAN document study *núcleos* are within the Río Cajonos watershed, including the PRM focus *comunidad* of Talea. In the style of Dan Gade's study of the Vilcanota (Urubamba) Valley of Peru showing vertical zonations (Gade 1975), the following is a brief description of the four sections of the Cajonos watershed, from upstream (most southerly) down. Each section is typified by a particular combination of physiography, climate, and vegetation.

Section 1: From the headwaters to Betaza, a village between Zoochila and Villa Alta in Figure 2.4, the valley is relatively broad. Rocks are mainly Tertiary andesitic tuffs, then Permian schists (SGM 2000). The river elevation averages about 1500 meters above sea level, and the surrounding mountaintops about 3000 meters. This is the "dry Sierra Norte": a rain shadow, with scrubby vegetation and *selva baja caducifolia,* including oaks, *Burseraceae* species, and some cactuses; vegetation is mainly disturbed.

Section 2: From Betaza to Tiltepec and Yagalaxi, the river cuts through a deeply incised landscape. Rocks are mainly Permian schists (SGM 2000). The river elevation averages about 900 meters above sea level, and the surrounding mountaintops about 2500 meters. This is the

[16] The river over its entire length is called the Tesechoacán in an 1885 hydrological map (García Cubas 1885). Some documents spell the river as "Cajones" (SEMARNAT and CONAGUA 2006), which means "boxes" or "crates."

"wet Sierra Norte": orographic rainfall during over half the year, with pine-oak forest, and some cloud forest above the river toward the end of the section. Vegetation well conserved in lower portion. Talea is in the upper part of this section.

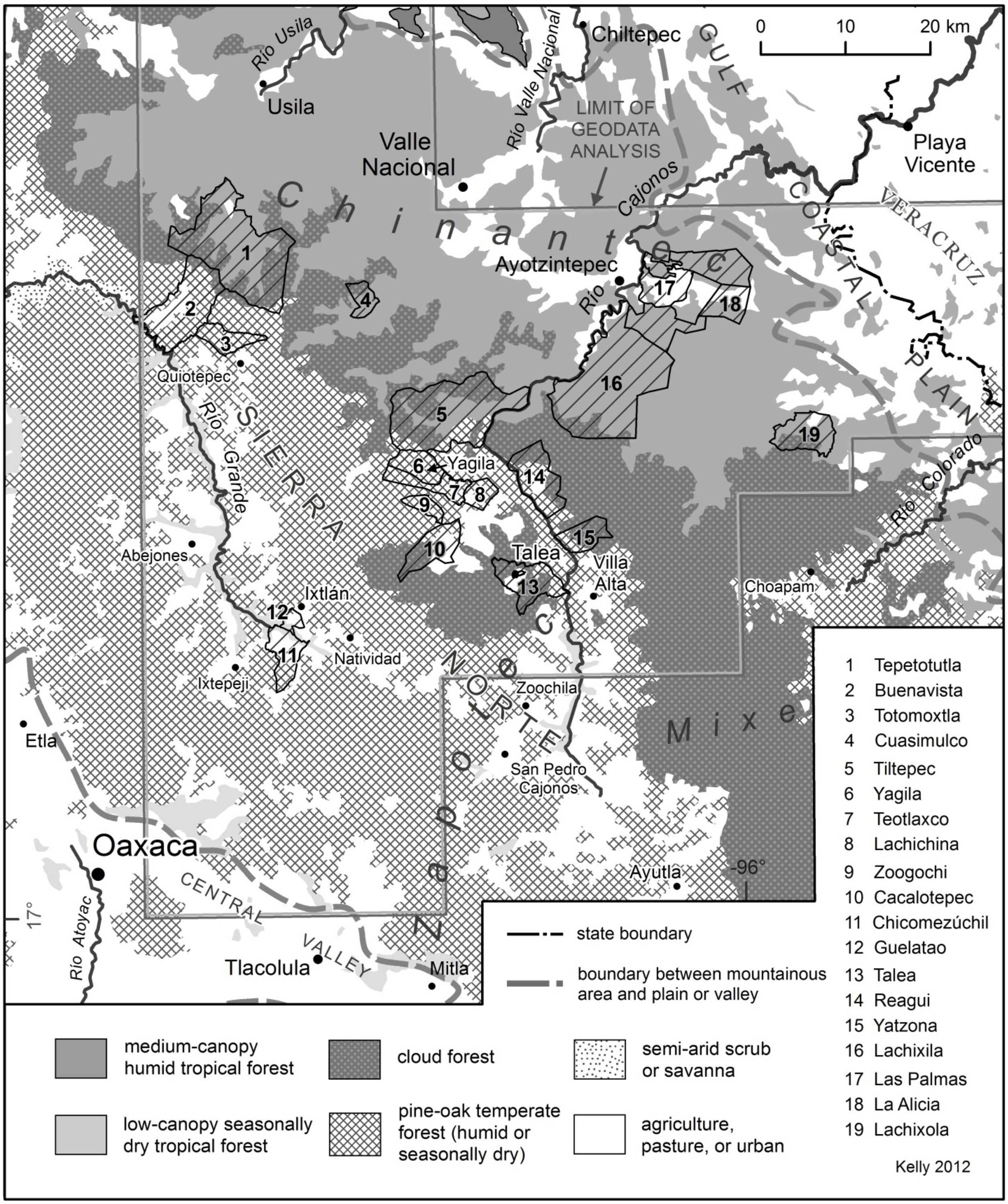
Section 3: From Tiltepec and Yagalaxi to San José Mano Márquez, a village 10 km north of Ayotzintepec in Figure 2.4. The river elevation averages about 200 meters above sea level, and the surrounding mountaintops about 1000 meters. Vernacular sub-regions here include the Rincón Bajo (Lower Corner) and Chinantla Baja (lower region of the Chinantec people). A somewhat incised landscape, rocks here are mainly Jurassic siltstones and sandstones, then Cretaceous limestones (SGM 2000). Humid tropical vegetation dominates, with some cloud forest above the river at beginning of section. The forests are well conserved in the upper part.

Section 4: North of the study area, from San José Mano Márquez to the confluence with Papaloapan River 80 km north of Playa Vicente, the river approaches sea level, and the surrounding land rarely reaches 100 meters above it. Rocks are mainly Tertiary mudstones and sandstones under alluvium (SGM 2000). This is the "Gulf Coastal Plain," with mostly disturbed tropical vegetation, originally *selva mediana y alta perennifolia* – evergreen medium and high-canopy rain forest.

2.2.2 Vegetation and land use

The original and potential vegetation of the Oaxaca geodata analysis area includes variations of the same general types in the Huasteca one. As in the Huasteca, the few relatively undisturbed forest patches of the Gulf Coastal Plain are dominated by mid-canopy humid tropical forest, though in the wetter Oaxaca region they verge on high-canopy rain forest. Between about 900 and 3000 meters, much of the Gulf-side slope is covered in cloud forest (although note that a broad definition of the term "cloud forest" was used for Figure 2.5, somewhat exaggerating its extent). The spine of the Sierra Norte follows the boundary between cloud forest and humid pine-oak forest visible in Figure 2.5, and includes a few patches of ericaceous alpine scrub on the most exposed peaks. The Cajonos and other valleys cut deeply into the Sierra Norte, in places allowing some Gulf moisture to penetrate beyond this high ridge.

Figure 2.5. Sierra Norte de Oaxaca study region: Land use and land cover, 2010. Zapotec, Chinantec, and Mixe language areas labeled in gray. Numbers indicate RAN document study *núcleos*. (Vegetation adapted from CONABIO 1999).



The lower parts of the Rio Grande valley are progressively drier, with oaks dominating from about 1100 to 1500 meters, and low-canopy dry tropical forest and xerophytic vegetation below 1100 meters. Southwest of Ixtlán another ridgeline traces the continental divide, as high as the aforementioned Sierra Norte spine and covered mainly in seasonally dry pine-oak forest. Finally, the Central Valley has long dry season, and was once covered in low-canopy dry tropical forest.

The great variety of vegetation types in a relatively small area has resulted in high biodiversity and regional (sub-state-scale) endemism (Dávila et al. 1997). Furthermore, the Sierra Norte "represents the northern limit for many montane Mesoamerican taxons, and is an important region for pteridophytes [ferns and their allies] and genera such as *Begonia*, *Quercus* [oaks], *Miconia* [of the Melastomataceae], and *Piper* [black pepper]" (García-Mendoza 2004, 315).

As in the Huasteca, the map of current land use and land cover (Figure 2.5) depicts extensive areas of anthropogenic disturbance, especially in the Gulf Coastal, mainly from cattle ranching, as well as in the Central Valley, from mechanized agriculture and large towns. The wide-ranging pine-oak forests of the Sierra Norte contain numerous agricultural areas, most of them not visible at the scale of this map, around the many indigenous villages that tend to cluster between 1500 and 2000 meters above sea level. Due mainly to its lack of sunshine, soggy soils, and economically less valuable tree species, the cloud forest band is the area least disturbed by agriculture, logging, and human occupation.

While there are many similarities in the material culture and lifeways among the villages in the study area, even in the several small-territory villages once dedicated to mining (e.g., Natividad, whose location is shown in Figure 2.5), a surprising degree of village-scale productive specialization exists. This spatial differentiation is rooted partly in the distribution of natural resources and climate, and partly in the chance events of history. Examples of village-scale specialization include Zoochila (mezcal), Talea (coffee), and the cluster of *núcleos* which including Ixtepeji and Ixtlán that are dedicated to community-based commercial forestry (Klooster 2003). These and other specializations are apparently surviving into the age of global commerce and telecommunications-enabled "national" culture. Indeed, several villages may be benefitting from increased export potential afforded by better transportation links.

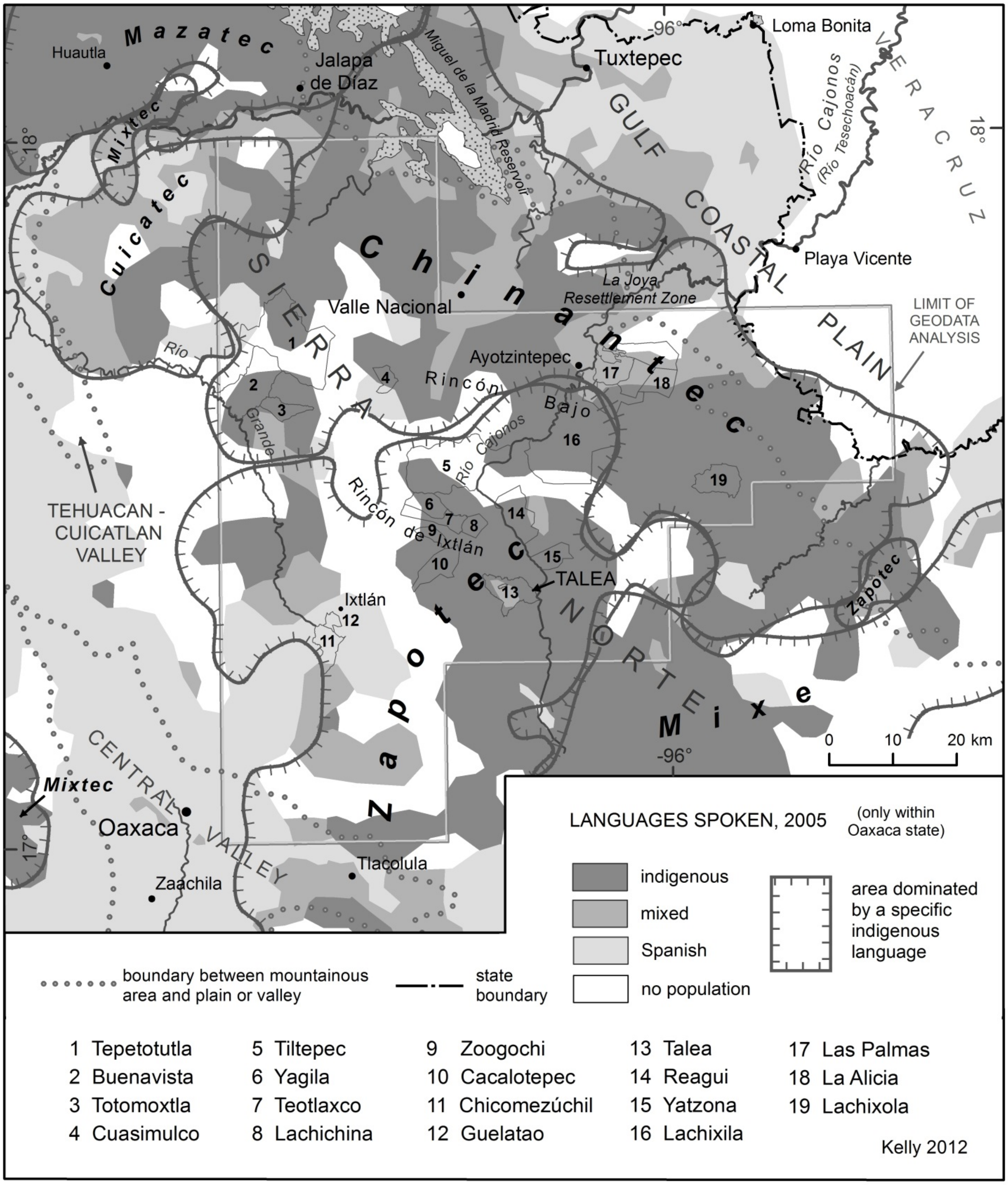
2.2.3 Indigenous and *mestizo* populations

The map of indigenous and non-indigenous (*mestizo*) language speakers and of specific language areas (Figure 2.6) shows that nearly all of the settled parts of the Sierra Norte are dominated by indigenous languages. An exception is the town of Ixtlán, where long-standing road access to the Central Valley has led to Spanish language dominance, although from my field experience I am certain that most of its residents consider themselves indigenous. Similarly, Ayotzintepec and Valle Nacional are large towns in lowland valleys with historic connections to the city of Tuxtepec and the state of Veracruz that have diminished indigenous-language populations.

The two principal languages of the Sierra Norte de Oaxaca geodata analysis area are Zapotec and Chinantec, both of the Oto-Manguean family. Along with Mixtec, Zapotec is one of the two most widely-spoken indigenous languages in Oaxaca. The Zapotecs of the Sierra Norte are concentrated in and around the major market towns of Ixtlán, Talea, and Villa Alta. They live mainly in the temperate pine-oak forest zone, as well as in a few villages in a humid tropical area called the Rincón Bajo. These "Sierra Norte Zapotecs" comprise one of the four major branches of Zapotec speakers. The other branches are the "Valley Zapotecs" (concentrated near Tlacolula), the "Sierra Sur Zapotecs" (in the mountain range closer to the Pacific Ocean), and the "Isthmus Zapotecs" (within the Isthmus of Tehuantepec, southeast of the study region) (Álvarez 2003, 307).

The Chinantecs occupy the same high-altitude pine-oak forest zone as the Zapotecs, but farther to the northwest, clustered mainly in villages near the market town of Quiotepec. Unlike the Zapotecs, they also live in a broad swath of lowland, humid slopes along the edge of (and a few kilometers into) the Gulf Coastal Plain. Several lowland Chinantec villages were relocated when the Miguel Aleman and Miguel de la Madrid reservoirs was constructed in 1959 and 1988, three of them to the La Joya Resettlement Zone shown in Figure 2.6 (Comisión del Río Papaloapan 1972; Valis 2010). The boundary between the Zapotec and Chinantec zones does not follow any especially notable physical divide, but communication between the zones was difficult until the Oaxaca-Tuxtepec federal highway was finished in 1958, and fully paved by 1982 (Álvarez 2003, 348).

Figure 2.6. Sierra Norte de Oaxaca study region: Indigenous, mixed, and *mestizo* population areas; and, specific indigenous language areas. Numbers indicate RAN document study *núcleos*. (Sources: INEGI 2005b; INEGI 2006a).



A third major indigenous population, the Mixe, live at the edge of the geodata analysis area. The Mixe language is closely related to Zoque, spoken in the Chimalapas region on the Isthmus of Tehuantepec at the Oaxaca-Chiapas border. Both languages are more distantly related to the Mayan family (Suárez 1983, 26). Like the Chinantec zone, the Mixe area includes both pine-oak highlands and wetter, lower slopes toward the Gulf Coastal Plain.

The rate of emigration varies greatly from village to village. Destinations include the United States (primarily the Los Angeles area), Mexico City, and Oaxaca city (Hirabayashi 1993, 76; López 2001). The 19 RAN document study *núcleos* have experienced low to moderate emigration in the past decade, and a few of them (e.g., Tiltepec) almost none at all. In contrast, between Quiotepec and Ixtlán are a handful of sizeable villages where most members of each resident family live elsewhere. In these *ejidos* and *comunidades*, remittances have sponsored the construction of fine homes and public installations, but only a few people, mainly elderly, live there to enjoy them.

2.3 33 núcleos*, the subjects of intensive research*

In this section, I briefly introduce the 33 *núcleos* which I researched in detail using RAN archival documents. (An additional three were researched, but found to have legally uncertain status as social property). In 15 of these, I also conducted participatory research mapping.

It should be noted that most villages in Mexico have two names which are often used together, on maps and in official documents: a patron saint name, followed by a unique name related to place. The unique name may be an indigenous toponym (e.g., "Tazáquil" or "Yagavila"), a Spanish descriptive toponym (e.g., "Buenavista"), or – as with many more recently established *ejidos* – a state-approved name honoring a person or event in Mexican political history, or a pioneer sentiment (e.g., "La Esperanza," meaning "Hope"). A further complication is that the unique name, even if it is of indigenous origin, is not always the name used by the indigenous language speakers of the village itself; this frequently occurs in regions where the Mexicas (Nahuatl-speaking Aztecs) had conquered (or had imposed extractive commercial ties with) the local indigenous group in the century before the arrival of the Spanish – e.g., "Dsioh Juøi Tien" is the Chinantec name for their village of Tepetotula (Merrifield and

Anderson 2007, 62). For clarity, in this study I generally use only the part of a *núcleo*'s name that is most commonly used by people in the region when they speak Spanish.

Three additional villages (Tampate and Piaxtla in the Huasteca, and Yatzona in Oaxaca) were found to have unresolved, legally ambiguous status as social property *núcleos*. Therefore, they are not included in most of the analyses. I have included them in Figures 2.1 through 2.6 to provide concrete examples of this seldomly acknowledged land tenure category. Because its boundary was surveyed by the government in 1981, Yatzona is also included in Figure 5.1.2.

2.3.1 15 *núcleos* in the Huasteca Potosina

The average area of the 15 Huasteca *núcleos* is 15 sq km, and the average population is 1,095. The largest *núcleo* in population is Tancuime, with 3,132 inhabitants; the smallest is El Chuchupe, with 143. The average percentage of indigenous language speakers in the 15 *núcleos* is 86 percent. Two *núcleos* have at least 99 percent indigenous language speakers (Santa Bárbara and Tancuime), while one (Las Armas) has only 39 percent. 11 of the *núcleos* are *ejidos*, and four are *comunidades*. 47 percent of the *núcleos* had individual-ownership parcels surveyed by PROCEDE; 40 percent had PROCEDE survey only the *núcleo* perimeter, or also a few civic parcels; and 13 percent were not surveyed by PROCEDE at all.

The *núcleos* generally lie where the Gulf Coastal Plain meets the easternmost ridge of the Sierra Madre Oriental. Most of them include some relatively flat, deep-soil territory typical of the plain (more suited to permanent agriculture), as well as some hilly, thinner-soil land typical of the Sierra (more suited to forest and generally non-commercial forms of traditional agriculture). Tanchanaco and Las Armas are the two *núcleos* which are entirely within the plain, but even Las Armas includes a low, forested hill which serves as its non-commercially-productive common use area. El Chuchupe's territory was, until a recent legal decree granted it a small extension into the deep-soil Coastal Plain, almost entirely within the shallow-soil Sierra. Six *núcleos* lie partly or entirely on the low sandstone hills of the Sierra Tancanhuitz.

Ten of the *núcleos* are within the Teenek-speaking area, and five are within the Nahuatl-speaking area. Las Armas includes significant numbers of both Nahuatl and Teenek speakers.

2.3.2 18 *núcleos* in the Sierra Norte de Oaxaca

The *núcleo* populations and other 2005 census figures were calculated by selecting INEGI localidades (rural census tract points) within the *núcleo* territories. In the unusual case of Talea, most of the population technically lives outside their *núcleo*, in a "donut hole" that is a populated place with a different legal name. Because this is the same group of people who own the territory of the legally-defined *núcleo* called Talea, for the purposes of this study they are considered the residents of that *núcleo*.[17] Among the RAN document study *núcleos*, the other example of a village's territory excluding the main settlement was Chicomezúchil. Unlike Talea, Chicomezúchil held this status *until* the 1992 reforms (until 1989, to be precise), not afterwards, a legacy of its history as a factory town later surrounded by agriculture (Pérez García 1996b, 340; RAN 1989c).

The average area of the 19 Oaxaca *núcleos* is 38 sq km, and the average population is 663. The largest *núcleo* in population is Talea, with 1,998 inhabitants; the smallest is Cuasimulco, with 103. The average percentage of indigenous language speakers in the 19 *núcleos* is 63 percent. Four *núcleos* have at least 99 percent indigenous language speakers (Cacalotepec, Reagui, Lachixila, and Tiltepec[18]), while one (Chicomezúchil) has only 1 percent. Two of the *núcleos* are *ejidos* (Las Palmas and La Alicia), while 16 are *comunidades*.[19] One of the *comunidades*, Chicomezúchil, was legally considered an *ejido* until 1978.

26 percent of the *núcleos* had individual-ownership parcels surveyed by PROCEDE; 42 percent had PROCEDE survey only the *núcleo* perimeter, or also a few civic parcels; and 32 percent were not surveyed by PROCEDE at all.

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[17] There exists an entire class of nucleos, Nuevo Centro de Población Ejidal (New Ejido Population Center, or NCPE), which shares this trait of the members living outside their territory. However, the NCPEs resulted from a specific late-20th-century program to grant land to qualified groups living in nearby cities (Ángeles and Ruiz 2000), while the case of Talea was a local, isolated decision.

[18] 100 percent of the residents of the village of Tiltepec speak Zapotec. Legally, their *comunidad* territory is shared with another village, La Luz, where 81 percent of the residents speak Zapotec.

[19] The preponderance of *comunidades* (rather than *ejidos*) in much of Oaxaca is due partly to the highly indigenous character of the state, but more to its principal colonial landholding pattern having been one of "small, unstable Spanish estates" rather than the "huge, semi-independent *haciendas* of the north" (Taylor 1972, 200).

All *núcleos* except two lie well within the mountains of the Sierra Norte. Three of these Sierra *núcleos* are in the Chinantec-speaking area. Tepetotutla, on the windward side of the range, has cloud forest in its upper zone and humid tropical vegetation in its lower parts, while Buenavista and Totomoxtla, on the leeward side, have temperate pine-oak forest covering most of their upper zones, and oaks and dry tropical scrub further down.

The Sierra Zapotec *núcleos* are clustered into two groups: a group of just two (Chicomezúchil and Guelatao) in the seasonally dry pine-oak zone of the upper Rio Grande valley; and the core group of eight *núcleos* in the mainly pine-oak forests of the steep slopes in the midsection of the Rio Cajonos watershed. Yagila, Teotlaxco, and Zoogochi belong to a vernacular subregion known as the "Rincón [Corner] de Ixtlán," since they fall within the *municipio* of which Ixtlán is the seat (*cabecera*). None of the Sierra *núcleos* are quickly reachable by paved road from either side of the range, but the three most isolated ones are probably Buenavista, Reagui, and Cacalotepec, although the last of these became more accessible in 2009 with the completion of the Rincón de Ixtlán loop road.

Besides Tepetotula, three other *núcleos* are on the lower slopes of the humid, Gulf-facing side of the Sierra Norte: tiny Cuasimulco, enormous Lachixila, and Lachixola. All three contain tropical rain forest, and the first two have some cloud forest on their upper slopes. Lachixila and Lachixola have, in recent decades, felt the effects of the advancing lowland cattle ranching front. Cuasimulco and Lachixola are in the Chinantla-speaking area, while Lachixila is in the partly Zapotec-speaking vernacular subregion called the "Rincón Bajo" (Lower Corner). All three villages are relatively isolated, especially Cuasimulco, which cannot be reached by standard motor vehicles.

There are two *núcleos* mainly within a flat lowland extension of the Gulf Coastal Plain, separated from the main plain by only a low limestone ridge: Las Palmas and La Alicia. These were included in this study to augment the sample of *núcleos* which requested that PROCEDE survey and certify their individual parcels. Some Chinantec is still spoken in both communities.

2.4 The núcleo *of Talea de Castro, Oaxaca*

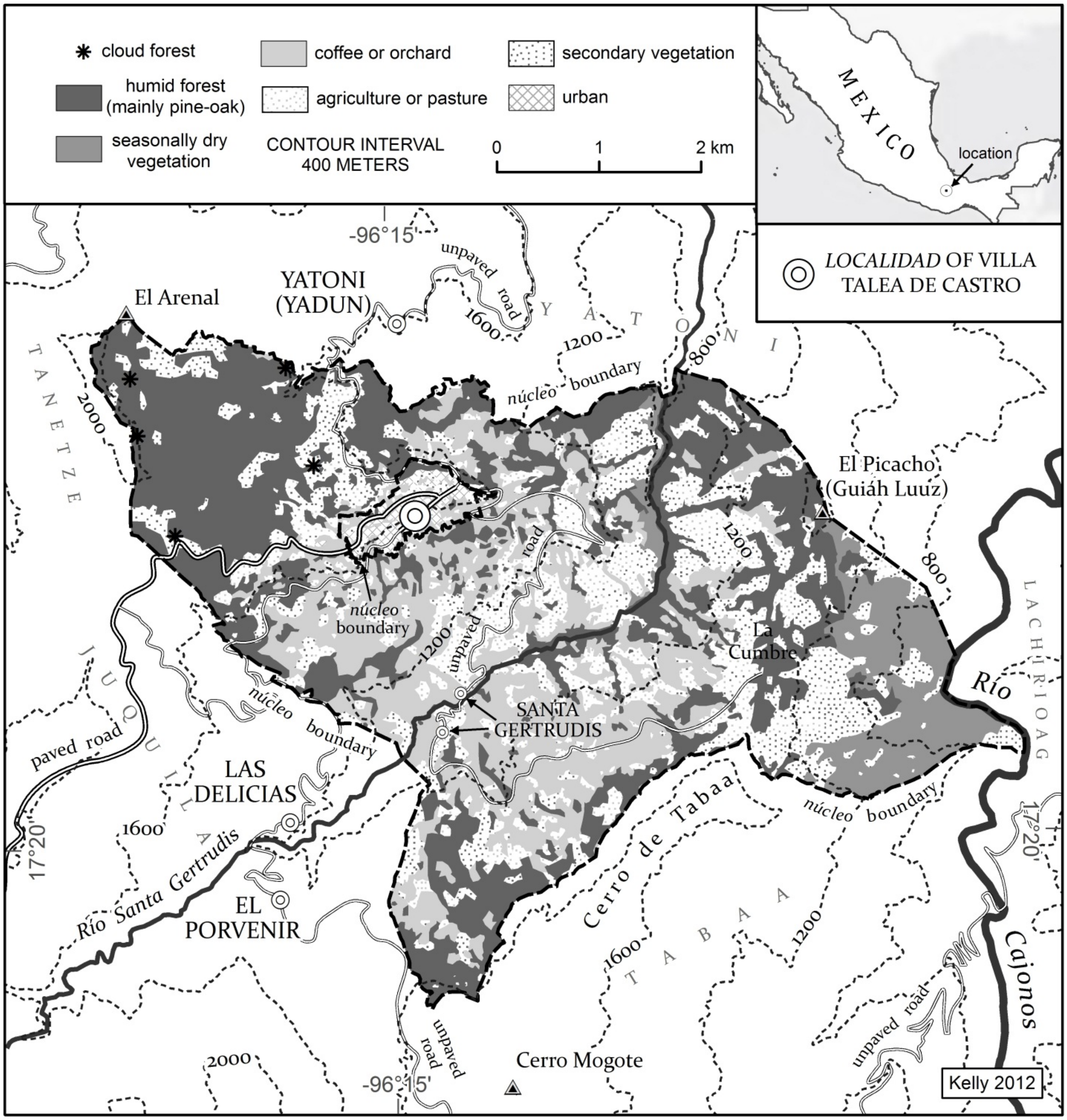
The *comunidad* of San Miguel Talea de Castro (Figure 2.7), called “Raleha” in Zapotec, was one of only four *núcleos* in the Sierra Norte de Oaxaca study region which chose to have PROCEDE survey and certify its individual parcels. Of these four, it is the only one which has never been an *ejido*, and only one of two where the majority of residents (53 percent in 2005) speak an indigenous language. The other Oaxaca study region *núcleo* with individual PROCEDE parcels and a majority of indigenous-language speakers is the *ejido* of Las Palmas, at the edge of the Gulf Plain. I chose Talea as the focus of this study for PRM work, and not Las Palmas, because Talea is located among the forested highland headwaters of some of the Río Cajonos tributaries, and therefore its water sources are probably more potentially important at a regional scale.

2.4.1 History and land tenure status

A visitor may find that Talea appears to be a typical Sierra Zapotec market town, like the similar-sized settlements of Villa Alta and Ixtlán. Unlike the older indigenous settlements around it, however, Talea was founded during the early Spanish conquest period. In 1525, a friar, Bartolome de Olmedo, “came from Mexico City to baptize Rincon Zapotecs, at request of Zapotecs themselves […] Olmedo founded his new settlement precisely on the border between Yatoni and Juquila, the lands presumably having been bought in small lots” (Nader 1964, 208). Talea remained a small village without much land of its own until the mid-1800s, when the Santa Gertrudis gold mine in the valley below boomed, and Talea grew to service the mineworkers.

In 1905, when the mine closed, “many of the miners, representing a variety of pueblos, came to settle in Talea where they began to farm for a living. Some of these miners were *mestizos* from the Sierra Juárez [Sierra Norte] who spoke Spanish and Sierra Zapotec, some of them from monolingual [Zapotec] Rincon villages such as Reagui and Cacalotepec” (Nader 1964, 208). While the community’s territory did expand somewhat, mainly through purchases from neighbors, the need to extract more economic benefit from relatively less land led Taleans

Figure 2.7. Talea (in Zapotec, "Raleha"): Principal geographic features. Land use and vegetation cover in 2010 is shown for both the *núcleo* of San Miguel Talea de Castro (outer polygon) and the *localidad* of Villa Talea de Castro (inner polygon). (Sources include INEGI 2002b and author's fieldwork.)



to be among the first Sierra Norte residents to embrace coffee as an important cash crop. By the 1920s, Talea was more prestigious than neighboring villages, but also more dependent on them for food staples like maize, until the road to Oaxaca city was completed in 1961 (and paved in the 1990s) as part of a regional road-building effort to support the supply of Sierra pulpwood to the FAPATUX paper mill in Tuxtepec (Montes Ramírez 2010, 64).

This atypical history has resulted in a hierarchy of administrative jurisdictions even more complex than the already complicated norm found throughout Oaxaca. The "Talea" which is the focus of this study is the *comunidad* territory formally called San Miguel Talea de Castro, owned collectively and individually by 993 *comuneros*. However, 90 percent of those *comuneros* do not live within that polygon. Except during occasional overnight stays in their ranch huts, usually during the coffee harvest, they live in a different legal entity, a *localidad* called "Villa Talea de Castro." (Here, *localidad* is not used in the INEGI sense of a "rural census tract point," but rather in the RAN sense of a "non-*núcleo* village in a predominantly social property area").

The 10 percent of Talea *comuneros* who *do* live permanently within the Talea *núcleo* territory are clustered in a hamlet called Santa Gertrudis, site of the late-19th-century mining operation. During PROCEDE work, this hamlet was surveyed as a human settlement area with about 20 *solares*. Like other Taleans, each of the hamlet's residents owns one or more parcels within the *núcleo* territory, and have certain rights to the common use areas. Santa Gertrudis residents conduct their own assemblies, where they make decisions related just to their hamlet, as well as participate in most of the full *núcleo* assemblies.

The idea of a single *ejido* or *comunidad* containing two or more population centers, a principal one where the general assemblies are held as well as one or more subsidiary ones with some measure of autonomy, is common in social property areas of Mexico. La Pila and Tancuime are two examples from the Huasteca Potosina. In some places, these subsidiaries are called "agencias," referring essentially to their status as a police precinct; in other places, they may be called "*ranchos*," although in Talea this word refers to a single hut on an agricultural parcel.

What is unusual about Talea is that its principal "urban zone" (human settlement) is not part of the *núcleo* at all. This was a decision made at the beginning of the PROCEDE process (interview with Miranda 2009), to better separate the functions and responsibilities of Talea as a county seat from its role as the place of residence of a group of farmers, even though the functionaries for both roles are drawn from the exact same group of people. The municipal authorities of Talea have two areas of jurisdiction and responsibility. First, they maintain services pertaining to the main population center, the *localidad* of Villa Talea de Castro, which includes a more recently developed neighborhood called Barrio Vírgen de los Pobres. Second, they handle certain matters pertaining to the county as a whole, which includes not only Talea but also Yatoni and Otatitlán to the north. INEGI maps insist that Las Delicias (a dispersed-settlement village southwest of Talea) is also part of the Talea county, but I found that the Taleans, who of course actually perform the functions in question, consider Las Delicias to belong to the county of Juquila.

The principal square in the main village of Talea is located at 17° 21’ 40” north, 96° 14’ 50” west. In UTM coordinates (zone 14N), this corresponds to 0792470 east, 1921660 north.

2.4.2 Physical geography and land use

Talea’s 2,851 hectares encompass 1,600 vertical meters, from the Cajonos River (at 480 meters above sea level) at the easternmost vertex, to the microwave tower near El Arenal (at 2,071 meters) at the westernmost vertex. Between these extremes lies another high ridge, the Cerro de Tabaa (named for the neighboring *comunidad* of Tabaa) and its continuation to the 1,696-meter hill El Picacho. The ridgeline between Cerro de Tabaa and El Picacho is known as “La Cumbre” (“The Summit”). Between this ridgeline and the higher one culminating in El Arenal lies the valley of the Río Santa Gertrudis. This river is also called, at various points, Río de la Cantera, Río de la Hacienda, and Río Rosario. This follows the Zapotec custom of giving different names to different stretches of river, each stretch conceived as unit bound with some land on either side, and this unit equivalent to a sub-village-scale place often called a *paraje* (Schmeider 1930, 14). This river arises on the flank of the 3,005-meter Cerro Siete Picachos, seven km southwest of the Talea boundary, and joins the Río Cajonos three km north of the Talea boundary. Within Talea, its flow averages 900 meters in elevation. The southern extreme of the *comunidad* is on the flank of the 2,013-meter Cerro Mogote, along the same ridge as Cerro de Tabaa.

The *núcleo* territory thus divides neatly into three slopes. From east to west, they are:

1. The east-facing slope draining to the Cajonos River. This relatively small area is also the driest, and least accessible, of the three slopes; it is covered mainly in semiarid and secondary vegetation.
2. The west-facing slope draining into the Santa Gertrudis River. This relatively long and narrow slope is moderately to very humid – it is wettest at the higher southern section toward Cerro Mogote. Most of it is intensely cultivated, mainly in coffee but also with some cattle pasture in the upper parts. The northern and southern extremes are forested: humid pine-oak at the higher southern end ("Yag Brubh" in Figure 6.7, on page 261), and the beginnings of a transition toward tropical forest at the lower northern end.
3. The east-facing slope draining into the Santa Gertrudis River. This large area covers about half of the total territory. The main population center of Talea was built about halfway up this slope, at around 1,600 meters above sea level. The lowest portion, above the river downstream from the hamlet of Santa Gertrudis, is only moderately humid, and non-coffee agriculture is practiced here. The microclimate is progressively more humid further up. Much coffee is grown below, and up to, the town. Above the town is a thick forest of humid pine and oak; little agriculture is practiced here now, although more once was. Large deer are sometimes seen here. In the highest part, especially along streams, there are a few patches of forest with some components typical of cloud forests, such as diverse epiphytes, mosses, and tree ferns of the family Cyatheaceae (Rzedowski 1978; Challenger 1998, 462).

The areas and percentages of each land use/land cover type are given in Table 2.1.

The paved road which ends at the Talea town center links it to the Central Valley of Oaxaca. Unpaved roads link Talea to Santa Gertrudis (this road was extended in 2008 up the far slope to La Cumbre), to Yatoni and Otatitlán, and to Las Delicias and El Porvenir. In 2005, this last road was extended around Cerro Mogote to shorten the travel time to the communities of Solaga, Tabaa, and Villa Alta. The old road to the district court town of Villa Alta featured prominently in anthropologist Laura Nader's study of Talean justice in theory and in practice

(1990), but it was never passable by motor vehicle, and is now just another path traversing the Talea polygon.

Table 2.1. *Comunidad* of Talea: Land use/land cover areas, 2010.

	area (ha)	**% of total**
Humid forest	1,071	37.6
Coffee or orchard	713	25.0
Secondary vegetation	480	16.8
Agriculture or pasture	368	12.9
Semiarid natural vegetation	214	7.5
Urban	5	0.2

3. Methods

The three principal sources for this study were archival research, participatory research mapping (PRM), and geodata analysis. To supplement this work, additional activities included directed interviews with *núcleo* authorities and government agency representatives, acquisition of records and data from CONAGUA, and analysis of secondary published sources.

3.1 Archival research: Social property documents (1923-2007) for 33 núcleos

The National Agrarian Registry (*Registro Agrario Nacional*, or RAN) stores records of interactions with social property *núcleos* (*ejidos* and *comunidades*) in offices in each state capital. These documents recount a wide variety of actions and information, mainly regarding legal land tenure interactions between a *núcleo*'s authorities and the government, but many describe issues and disputes between individuals living in a *núcleo*, or between an individual and the *núcleo*'s authorities. The files for some *ejidos* and *comunidades* are more complete and detailed than those for other ones. Since the inception of the PROCEDE program in 1993, the Oaxaca and San Luis Potosí state offices maintain these documents in two separate locations for each state: a Historical Archive (*Archivo Histórico*) for the period before 1993, and a General Agrarian Archive (*Archivo General Agrario*) for the period since 1993, though some older documents are also found in the latter location.[20]

These files are available for public viewing, one *expediente* (*ejido* or *comunidad* dossier) at a time. I inspected all documents for 36 *núcleos* (19 in the Sierra Norte region of Oaxaca and 17 in the Huasteca region of San Luis Potosí, including three which were found to have lost or never secured legal social property status). The *núcleos* were chosen based on three criteria: first, that they include the twelve villages where I had already completed participatory research mapping work as part of the México Indígena team; second, that they embrace a variety of *núcleo* types, particularly regarding de jure land tenure status; and third, that together they form parts of two reasonably compact geographical zones.

[20] All documents from the RAN archives are listed in the References section with RAN as the author.

For 17 of these *núcleos*, I also acquired official paper copies of property maps produced by PROCEDE and FANAR surveys, 11 of which had been obtained during the México Indígena project. Depending on the work done in a *núcleo*, these maps show *núcleo* perimeters, internal land tenure zones (parceled areas, common use areas, and human settlement areas), or individual parcels.[21] Upon its being surveyed, each parcel is given a number which is related to an individual owner (including, in the case of "civic parcels," the *núcleo* itself as owner) through booklets often called *Asignación de Parcelas*. Copies of these, too, were acquired and analyzed, for those *ejidos* and *comunidades* which underwent the PROCEDE process. Because they are found in the same dossiers as other archival RAN documents, they are listed in the References section with RAN as the author.

Geographer Michael Roche (2000, 145) described archival research as "somewhat akin to confidently accepting the challenge of working on a jigsaw puzzle where you can be certain that pieces are missing and that the box cover with the picture of the completed puzzle will never be found." Studying the RAN archival documents, I paid close attention to two kinds of items: first, anecdotes and facts which suggest individual or village-scale practices, traditions, or innovations; and second, anything which related to water. In this context, an "anecdote" is an event, description, situation, or opinion recounted by someone – usually an individual villager, a *núcleo* authority, a government agent, a judge, or a neighboring landowner – which provides evidence of a personal, interpersonal, or institutional practice. I encountered many examples of individual or village-scale practices, but mentions of water were relatively scarce. Taken together with the other sources of data, particularly my participatory mapping experiences, the historical examples illustrated by these anecdotes contributed enough information to produce what is essentially a thematically focused ethnohistory of the study regions.

"Communal statutes" are *núcleo*-level documents that codify the assembly's by-laws and certain regulatory practices. The only such documents normally stored in the RAN files are "boilerplate" versions; that is, standardized government texts adopted by a *núcleo*'s assembly

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[21] Because INEGI was the primary agency responsible for cartographic work for the land tenure surveys, the PROCEDE maps ("Planos Producidos para el Registro Agrario Nacional") are listed in the References section with INEGI as the author.When the PROCEDE program ended in 2006, the responsibility for any new survey maps in nucleos shifted to FANAR. Because the RAN became directly resoponsible for cartography, it is listed as the author for the map produced through FANAR for the *comunidad* of Tiltepec.

with little or no modification, often as part of the PROCEDE process. The two such statutes I examined in detail were for the *comunidades* of Yagila (RAN 2001b), and Santa Bárbara (RAN 1999f).

To facilitate content analysis, I entered all the collected data and anecdotes in an Excel spreadsheet, with each column representing a theme or question (e.g., "post-PROCEDE-certification anecdotes suggesting individual water source ownership") and each row a *núcleo*. From this I identified patterns and chose illustrative anecdotes (see chapter 5).

I georeferenced the PROCEDE maps in ArcGIS, creating shapefiles for land tenure areas. I used these coverages to produce tenure maps of each *núcleo* (Figures 5.1.1 through 5.1.9) and combined them with INEGI topographic layers to qualitatively analyze relationships among land tenure, water sources, and other geographic features. For the *núcleo* boundaries and land tenure polygons, as for all geo-spatial data, I used whichever data source was most accurate for each *núcleo*. Several of the 33 *núcleos* were surveyed by PROCEDE, but I did not possess the paper PROCEDE-generated maps; their perimeters and tenure areas were located by digitizing polygons displayed in the Mexican government's GAIA web-based GIS portal (INEGI 2011).

The *núcleos* which were never surveyed by PROCEDE were more difficult to map accurately, but I was able to find ways to locate each one reasonably well. In the case of Yatzona, for example, the *núcleo* happens to be coterminous with a *municipio* of the same name, so I could substitute an INEGI *municipio* shapefile. For Guelatao, the perimeter had been located by participatory GPS fieldwork during the México Indígena project. For Cuasimulco, I had fortuitously acquired its boundary coordinates in 2003 while doing work for World Wildlife Fund-Oaxaca. The most challenging *núcleo* to map was Lachixila, in Oaxaca. It did not appear in the GAIA layer, because it had never been officially surveyed by PROCEDE, even though its PROCEDE-era (1995) perimeter survey was legally equivalent. I was able to piece together its perimeter by combining the "negative space" of neighboring *núcleos* which did appear in GAIA with the sketch I had made of the 1995 map in the RAN office, supplemented by referring to the part of the boundary representing a physical entity (the Río Cajonos), and finally with the addition of four GPS points I happened to have taken when visiting the *núcleo* in August 2007 as part of my brief reconnaissance of the "Rincón Bajo" area.

3.2 Participatory research mapping (author as team member) in 12 núcleos

Participatory research mapping (PRM) is a social science approach, used alone or in combination with other methods by an increasing number of geographers and others, in which geographic data are defined, collected, displayed, and put to practical, creative use in great part by nonprofessional, often indigenous "local investigators." In a general sense, PRM is part of the postcolonial thread of applied social science research (Crang 1992; Hall 1993), which asks that "geographers construct more 'polyphonic' geographies as a way of reconfiguring academic authority in relation to 'research subjects'" (Jacobs 2003, 351), but its deeper roots include the 1920s field techniques of Carl Sauer, whose "conversations with Mexican peasants were not about how much he, the professor, knew, but what they could tell him about their agricultural and material life" (Gade 2012, 341).

In this section, I review the components and evolution of PRM, provide a basic description of how the method was implemented by the México Indígena research team, and give details about my own implementation of the method in the village of Talea. Fuller accounts of the México Indígena experience appear in Herlihy et al. 2008 and in Smith et al. 2009.

3.2.1 Participatory research mapping: Techniques and history

A fully participatory research mapping project would generally include the following steps, which I have partly adapted from the description by geographers Peter Herlihy and Gregory Knapp (2003, 307-308).[22]

1. The academic researchers or NGO facilitators train local investigators, chosen by their own communities, in skills which are both relevant to the PRM project and useful afterwards. Today these include GPS use, and sometimes basic GIS database and cartographic production techniques.

[22] Participatory mapping (PM) is a method with several tasks in common with PRM. Because academic findings are not a primary goal of PM, any academic researchers or NGO facilitators initiate a PM project without preconceived research objectives.

2. Through an unhurried, iterative process of collaborative fieldwork and group meetings, the local investigators and community residents, working with the researchers, convert “cognitive” mental maps to “consensual” maps.

3. The team members anchor the PRM products (mainly maps) to a specific location and time, only including features whose nature, name, and coordinates have been locally verified.

4. The PRM research team converts the “consensual” maps to “standardized” maps; i.e., in a format legible to a wide range of potential audiences. Most of the actual computer-based work is usually performed by the academic researchers, but always in an iterative process of improvement and verification with the local investigators and communities. For example, the 1993 Darién (Panama) PRM project “focused on the systematic collection of toponyms to locate the resource use site[s] and define subsistence lands. […] The PRM methodology emphasizes the dialectic between the researchers and surveyors to transform the toponyms, sketch maps, air photos, and other information into standard maps and descriptive form” (Herlihy 2003, 325). Some, however, contend that PM and PRM in indigenous communities need not include the step of cartographic standardization (Vermeylen, Davies, and van der Horst 2012, 122).

5. The communities then use the maps (or not) for whatever purposes suit them. Typical uses can include education of younger community residents, interactions with government officials or NGOs for specific purposes (e.g., building a road, or defining a boundary), or as part of a larger political action. Examples of “much needed proofs of evidence for adjudications of the prior rights of indigenous peoples” (Jacobs 2003, 350) have included PRM efforts by the Yanyuwa of Australia (Baker 1999); the Embéra, Wounaan, and Kuna of Panama (Herlihy 2003); and the Miskitu, Pech, and Tawahka of Honduras (Herlihy and Leake 1997; Herlihy 2011; Nuila Coto 2011).

6. The academic researchers may “scale up” the PRM results and understanding of other data. These findings are often published in peer-reviewed journals, and sometimes serve as part of an effort to advance the geographic understanding among government policymakers.[23]

It is important to note that beyond the tangible “products” of PRM (standard maps, GIS databases, academic articles, etc.), the very act of participatory mapping can have real

[23] The American Geographical Society Bowman Expeditions, for which the México Indígena project served as the prototype, is a notable example of the latter purpose (Herlihy et al. 2008).

consequences. These may include a new geographic awareness in all who participate (including children), or a reinvigorated community focus as the “communicative action” of the PRM process is transmuted into an “instrumental action” (Silk 1999, 11).

Mohamed Mohamed and Stephen Ventura (2000, 230) specified how PM or PRM was sometimes applied to the problem of indigenous territoriality and its relationships to standard tenure maps such as cadastres:

> Geo-coded participatory mapping activities start with conventional participatory mapping, where informants representing a family, community, or other relevant group draw a physical map of their areas(s) to clearly show the limits of ‘parcels’ or ‘ownerships’ (however various usufruct rights are conceptualized). […] An increasingly common method for geocoding participatory maps is acquisition of positional data with GPS receivers. […] Collected positional information (e.g. boundaries, resources points) and associated descriptive characteristics can be analyzed in a GIS or used to generate ‘indigenous parcel maps.’

In the application of PM or PRM techniques to the more specific problem of water sources and indigenous land tenure, a recent pioneer has been John Yumbya, who assisted rural residents in Kenya with locating and mapping springs to improve their management and water productivity (ABCIC 2010).

Several of the prototype projects for participatory research mapping as a method date from the early- to mid-1990s, when involvement of local communities proliferated in all types of research and development (Herlihy and Knapp 2003, 306). Besides the efforts in Darién and Honduran Moskitia, pioneering projects from this period included those in the Canadian Arctic (Rundstrom 1991) and in Nicaraguan Moskitia (Nietschmann 1995). In the late 1990s and early 2000s, Latin America in particular evolved as a locus for further experimentation in PRM, often to “document indigenous occupancy and substantiate territorial claims” (Smith 2003, 334). Projects included those in Nicaraguan Moskitia (Dana 1998) and in eastern Panama (Smith 2003). Peter Poole[24] (1998) and Peter Herlihy (2002) have assessed several efforts from this period.

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[24] More recently, Poole has worked to advance techniques in local interpretation of remote sensing imagery in Belize (Indigenous Mapping Network 2011), and tenure mapping with the Dinka of Sudan (Poole 2009).

In the 2000s, PRM techniques were increasingly used, most directly by human geographers to "highlight spatial and temporal dimensions" of social issues, usually "where people's relations with, and accounts of, space, place, and environment are of cultural interest" (Pain 2004, 653). Indigenous territoriality continued to be a common focus, as part of research in how certain cultural identities are tied to place (Kindon 2003). Two graduate students in geography used PRM for studies with parallels to my work as an individual researcher in Talea. The first was by Derek Smith (2002, 55), who "undertook participant observation, conducted interviews, carried out field mapping, and accompanied hunters during their activities" in the Buglé lands of Panama, while "training local investigators to conduct a census, facilitate community mapping sessions, and administer hunting activity questionnaires." The second was by Nina Goschenhofer (2007, 88), who used PRM to explore territoriality in a Wixárika (Huichol) community in Jalisco state, Mexico. The cognitive, community, and standardized maps she and the villagers produced revealed the importance of water "deposits" (springs and reliable stream uptake points). These water sources were among the first things mapped, especially those at the forest/agricultural margins, where there have been conflicts with neighboring non-indigenous communities over water access.

By the end of the 2000s, even an international, UN-affiliated NGO was offering guidelines for "best practices" in participatory mapping (IFAD 2009), although without an emphasis on creating standard-format products: "participatory mapping is not defined by the level of compliance with formal cartographic conventions" (IFAD 2009, 7). With the expansion in the use of PM and PRM, criticisms also arose. Some found that the method could perpetuate an essentializing of power, or a romanticizing of the poor (Pugh and Potter 2003). Three other contentious issues which accompanied the proliferation of PRM were overly optimistic claims, especially regarding GIS; a confusing association with techniques employed by academics embedded in US military ground forces; and a lack of rigor in the method's application by some well-intentioned rural planners, especially in Latin America.

As some kinds of GIS software became somewhat less expensive and, especially via Internet applications such as GoogleEarth, more widely available, certain academic, NGO, and government proponents helped develop a loose collection of methods called "public participation GIS" (PPGIS) which partly overlap the methods and goals of participatory research mapping (see, e.g., McCall and Minang 2005). While there are many examples of indigenous participation in GIS (e.g., Knight 2011; Palmer 2012; Pyne and Fraser Taylor 2012), the computer (and Internet) access, and the GIS software training, required for many projects renders many of the PPGIS claims to non-expert involvement as overly optimistic (Cochran 2009; Graham, Hale, and Stephens 2012). PPGIS has also been critiqued for not always fully addressing ethical issues such as “control and ownership of geographical information” and “representations of local and indigenous knowledge” (Dunn 2007, 616). By the end of the decade, yet another branch of activities was emerging from technologies related to PPGIS: “volunteered geographic information” (VGI), which typically refers to untrained (but well-equipped) citizens uploading geocoded text messages, images, and videos to GoogleEarth (Zook and Graham 2007; Boulton 2010). While not usually part of an organized effort with well-defined products, VGI can share some goals with PRM. Though it does not create statistically valid samples, it can help raise awareness and challenge state power, as it did by producing alternative “crisis maps” after the Szechuan, China earthquake in 2008 (Lin 2011).

In the aftermath of many horrific mistakes committed by the US Armed Forces in the wars in Afghanistan and Iraq, some in the Defense and State Departments looked to certain social science techniques, some of them resembling parts of the PRM method, to improve human geographic understanding in conflict and occupation zones. “Human Terrain Systems” (HTS), a small program which “embedded” social scientists in military units, was one effort whose techniques drew some inspiration from parts of the PRM approach. While the intent may in theory be admirable, the efforts have caused at least two serious problems. First, because military deployment is so far removed from the academic context, the complexities which PRM practitioners always face to conform to human subjects ethical guidelines are multiplied (Cahill 2007, 360). Second, the controversial history of US military interventions across the globe understandably arouses suspicions regarding intent among potential PRM collaborators (including indigenous communities) – suspicions which have, sadly, been allowed to cast a pall over some mutually beneficial projects, and to create unnecessary divisions among academics. Despite these problems, the HTS approach did achieve some local, and ethically sound, success in Afghanistan (Griffin 2011). Perhaps the groundwork is gradually being laid for better understanding by all parties, even if these initial attempts at a rapport have upset the assumptions of some observers.

In parts of Latin America in the 1980s, Carl Sauer-influenced cultural ecology combined with an interest in landscape analysis studies to produce a rational, goal-oriented blend of human and physical academic geography (Urquijo and Bocco 2011). By the mid-1990s, NGOs and government agencies, particularly those seeking to promote a healthy balance between conservation and development, were employing parts of the participatory research mapping methodology to specific problems of community-scale rural land planning (Toledo 1995). Such a project is typically called an *ordenamiento territorial* (roughly, “territorial regulation framework”).The community consensus which ideally emerges is sometimes given a legal imprimatur, such as by the government’s equivalent of the Environmental Protection Agency, or through the local rules of the community itself (for recent examples in Mexico, see Instituto de Geografía et al. 2009; for an academic critique of examples in Colombia, see Kiran and Ojeda 2009). While the proliferation of *ordenamientos territoriales* does indicate a growing acceptance of some tenets of PRM, only rarely are all the steps taken; in particular, the first step – avoiding narrowly-defined, preconceived research objectives – is unlikely to be followed by an NGO or government agency with a specific donor- or taxpayer-funded mandate.

3.2.2 The México Indígena project

The México Indígena project combined archival research, analysis of land tenure, census, spatial and other data obtained from government agencies, and fieldwork in 11 indigenous communities as part of the first ‘Bowman Expedition’ led by the American Geographical Society (Herlihy et al. 2008). The investigation began in 2005 as a collaboration between the University of Kansas and the Universidad Autónoma de San Luis Potosí (UASLP), funded in part by the Foreign Military Studies Office (FMSO) of the US Army. It was focused on, but not limited to, a new understanding of land tenure practices since the 1992 reforms. The research team included more than 20 people, among them experienced researchers, graduate and undergraduate students, and trained local indigenous investigators.

After extensive consultations with the Tenek, Nahua, and Zapotec communities which chose to participate, each community selected a representative to be trained as a local investigator. Workshops, interviews, the administration of questionnaires, and participatory mapping took place each summer through 2008. The two regions were chosen because of their strong communal traditions and indigenous self-identity, and for the contrasting rates of PROCEDE participation between the two regions. Additional information came from interviews with people working for government agencies who were directly involved in the PROCEDE program, ranging from members of survey crews, to people managing and reviewing cadastral data, to high-ranking administrators at state and national levels. All study communities received multiple digital and printed copies of their final community maps (Smith et al. 2009, 178-181).

The results of México Indígena work used specifically for the present study include 106 geolocated, verified hydrology point features, including 53 springs in three Sierra Norte de Oaxaca *núcleos* 45 springs in nine Huasteca Potosina *núcleos*.

During the summer of 2008, when my preliminary dissertation fieldwork coincided with overall México Indígena work, I received exceptional assistance from local investigators Ramón Ramos Jerónimo and Rigoberto Cruz Hernández, and from UASLP student researcher Gerardo López Roque, in identifying specific links between water sources and land tenure in the *núcleo* of Yagila. Other contributors included Estrella García, Marco A. Martínez Galicia, Taylor Tappan, and four local residents who remain anonymous here. In the *núcleo* of Tiltepec, I received exceptional assistance from local investigators Emigdio Gregorio Hernández and Bonifacio Hernández Montaño, and from geographer Scott Brady. Other contributors included Aida Ramos Viera, Marco A. Martínez Costilla, Derek Smith, and Hylian Lobo Guerrero Serrano. In both *núcleos*, geographic information was exchanged both during walks to take GPS points as well as during interviews. I also made use of three sketch maps created by a subset of *comuneros* in Tiltepec in fall of 2008 under the supervision of Marco A. Martínez Costilla, entitled “Mapa de Zonificación de San Miguel Tiltepec,” “Mapa de Sona [*sic*] de Bio-hidroagro Forestal,” and “Zona de Reserva de Recurson Hidrológicos.”

For the Huasteca study area, I found for the following sets of México Indígena products especially useful:

1. Community questionnaires for all nine *núcleos*, supervised during village assemblies by UASLP student researchers Carlos Bonilla Jiménez, Aida Ramos Viera, Gerardo López Roque, Martha Elena Ramírez Espinosa.

2. 117 parcel/household questionnaires, in all nine *núcleos*, administered to a non-random but broadly representative sample of heads of household who own de facto or de jure parcels. Some questions related to one of their parcels (whose boundaries were geolocated with GPS), while others related to all their parcels, and still others to their house and household. These were administered mainly by the same four student researchers, joined by Jacinto Jiménez.

3. Maps of five *núcleos* in the Huasteca, in which all (PROCEDE-certified) parcels were assigned "land use" and "de facto recent ownership transfer" values by small groups of key local informants, in meetings organized by Carlos Bonilla Jiménez, Gerardo López Roque, and Jacinto Jiménez. Besides providing me with informal transfer rates, this data set allowed me to discount parcels inherited through the owner's death; these accounted for 77 percent of the total.

4. Notes from directed group interviews about common use areas for two *núcleos* (Tancuime and Cuatlamayán), conducted by Gerardo López Roque and Jacinto Jiménez in July 2006.

5. The nine final PRM community maps delivered to the *núcleos*.[25] Scales vary; generally the data is appropriate to a scale of about 1:10,000. I reiterate that "the final maps include information that they specifically requested, and we did not put anything on the maps that they did not want included" (Smith et al. 2012, 124). Two *comunidades*, Tiltepec and Yagila, subsequently requested that their maps be removed from circulation, and their association with the project be discontinued, after some members of each community expressed irritation that it has not been clear to them that the FMSO was a source of the project's funding.

Another data source acquired by the México Indígena team was a set of *Historiales Agrarios* (Agrarian Histories). After PROCEDE, any *núcleo* which had undergone certification of individual parcels could formalize any subsequent parcel transfer by registering it with the state Rural Cadastral Office. The *Historiales Agrarios* include updated lists of these de jure

[25] In the References section, the author of these maps is "México Indígena Research Team." The publisher is the American Geographical Society, lead organizing body for the project.

transfers, and are available to the public on request (RAN 2006c). In 2008, assisted by Aida Ramos Viera, I processed these documents for all five PROCEDE-parceled Huasteca *núcleos* where México Indígena did fieldwork.

Miscellaneous hard-copy items acquired or processed during México Indígena fieldwork included the 1801 last will and testament of a Yagila resident; 1995 1:20,000-scale INEGI air photographs of Huasteca communities and their surroundings; and a 1969 map of the irrigation system and internal tenure of the *núcleo* of Guelatao.

Parts of this study draw from a semi-participatory research mapping experience I had as part of a different team previous to the México Indígena project. For seven months in 2003 and 2004, I served as GIS database manager, GPS training supervisor, cartographer, geographic analyst, and assistant meeting facilitator with CAPLAC (Capacitación y Planeación Comunitaria A.C.), a consulting service consisting of a Oaxaca-based couple (Beatriz Solís and Aaron Ramírez Lara) who hold agronomy and anthropology degrees. During the project, funded by World Wildlife Fund under the supervision of Javier Castañeda, four Sierra Norte indigenous communities, the Chinantec *núcleos* of Totomoxtla, Buenavista, and Nieves and the Cuicatec *núcleo* of Teponaxtla, collaborated with the three consultants to produce detailed maps and descriptive documents that strongly resemble some of the output of México Indígena. By coincidence, the *núcleos* are located only 20 km from the ones where México Indígena did work, allowing me to incorporate two of the CAPLAC *núcleos* into the present study. These two *comunidades* are Totomoxtla and Buenavista, where the CAPLAC fieldwork happened to have paid special attention to water sources and locally-defined de facto land tenure. The main distinction of CAPLAC as compared to México Indígena was the main goal of CAPLAC: to help the communities generate *ordenamientos territoriales* which would strengthen conservation of flora and fauna while improving the local economies, especially via sustainable commercial forestry.

3.3 Participatory research mapping (author as sole researcher) in núcleo *of Talea*

In September 2008, after conferring with José Luis Cruz Piñeda, regional director of the CDI (Comisión Nacional para el Desarrollo de los Pueblos Indígenas), I first visited Talea, and explained to the municipal authorities my idea of facilitating a participatory research mapping effort. They explained to me Talea's unusual territorial division into a main population center administered by the *municipio* and a separate, PROCEDE-surveyed "agriculture and forest" *comunidad*. We agreed that my interests, and the needs of the community, would be better served by working with the *comunidad*, since that is where nearly all the water used by Taleans originates, and because PROCEDE had worked there but not in the main population center.

I made initial contact with *comisariado* Jaime Andrés Rodríguez, the *comunidad*'s principal authority, known informally as "*el comi*." Jaime was impressed work by México Indígena, and proposed that an accurate map featuring local toponyms would likely serve multiple uses. He suggested that we arrange a meeting with the other *núcleo* authorities when my own fieldwork began the following January, and that two local investigators be chosen at that point. We estimated that it would take us about three or four weeks, spread over two or three months, to complete the GPS fieldwork, toward the end of which we would call at least one larger meeting, attended by several "*ancianos*" (long-term residents with deep geographic and historical knowledge), to validate and discuss the development of the community map.

At the meeting in late January 2009, I agreed in writing that I would pay each local investigator for the time they devoted to the work; that I would train them in the use of a handheld GPS device; that the community map would include whatever data the Taleans wished to include, but omit whatever they wished to omit; that I would donate the GPS device to the *núcleo*; that I would deliver three full-scale paper copies and two digital CD copies about three months after the fieldwork had ended; and, that I would offer my services to assist with a reasonably-sized geo-technical task of their choosing. In return, they agreed to answer questions related to my own research interests, specifically pertaining to GPS points taken as well as more generally in unstructured ad hoc interviews.

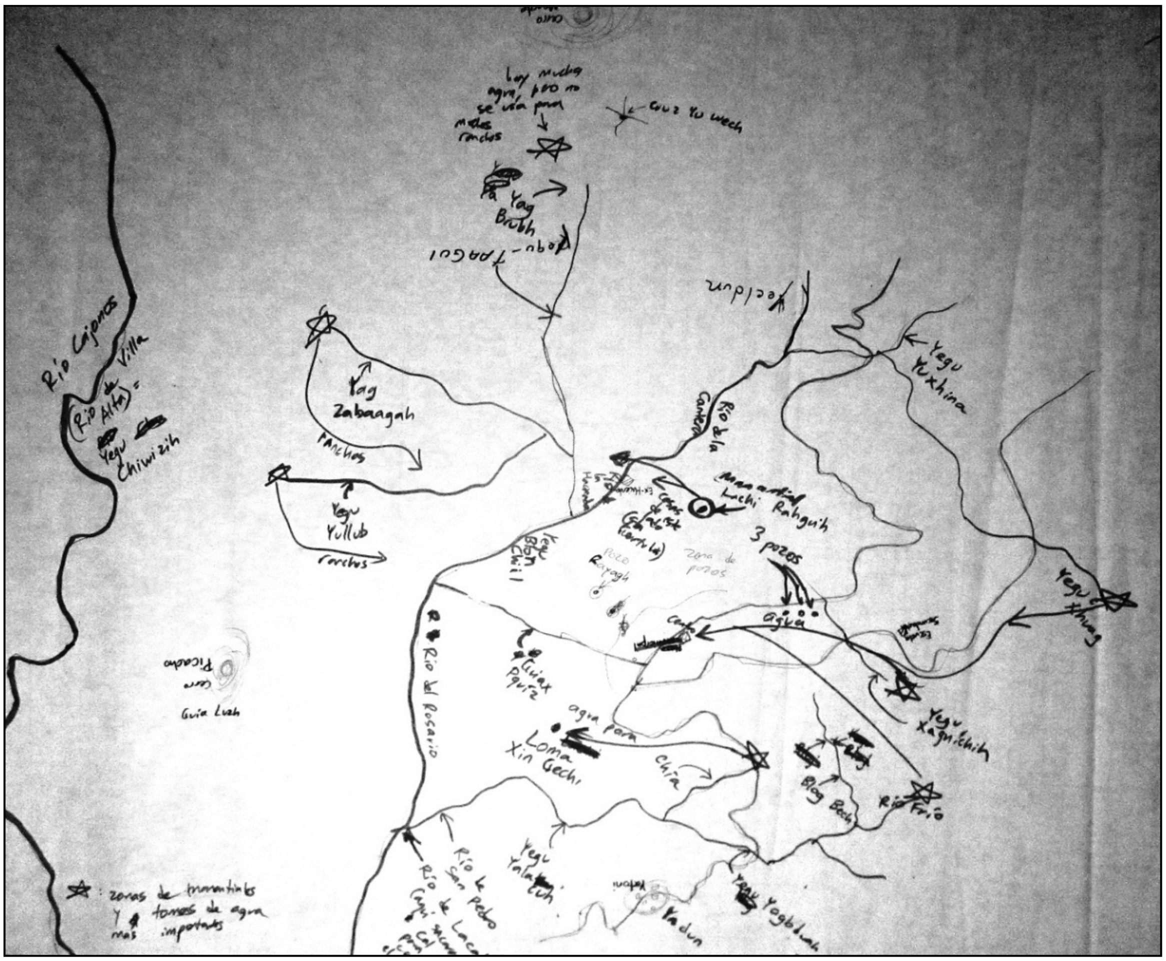
To my delight, the *comi* and the selected principal investigators decided, without any prompting from me, that "water sources" were a feature they were especially interested in including in the map and as part of the overall work. The principal local investigators were *presidente de vigilancia* (security committee head) Ivan Pascual García and *secretaria de vigilancia* (security committee secretary) Maurilio Toro Yescas. On six occasions, I was accompanied instead by either of two other local residents. When in Talea, I would reside at the Hotel San Carlos, a remarkably comfortable, little-used facility that had recently been built by a prosperous Talean.

Between January 28 and March 19, 2009, the local investigators and I collected 196 points using a Garmin GPSMap 60 device. Notes on each point were written I notebooks, at first by me but later by the local investigators, along with point number, coordinates, and positional error (all fields except notes were stored in the device, but repeated in the notebooks to provide security through redundancy). We visited all parts of the *núcleo* territory, although we didn't walk on every path or to go to every parcel. About half the GPS points were related to water, while the rest marked turns in major paths, changes in land use or land cover, named places, changes in land tenure, and other features.

In the mornings and evenings, such as over a game of basketball or while enjoying a local meal, I talked with many Taleans. Four of these talks were lengthy enough to be considered unstructured interviews: a discussion with municipal water committee representative Isidro Pérez Cruz, and conversations with three other *comuneros* whose pseudonyms in this study are Belisario Miranda, Felicia Méndez, and María Ribero. A product of my talk with Isidro was his letter-sized schematic sketch map showing the potable water system (sources and main conduits) for Talea's urban zone. A fifth *comunero*, an *anciano* (elderly person), assisted me by affixing toponyms to a letter-sized drawing I had made of the village landscape including approximately half of the *núcleo*'s territory.

In March, a workshop took place to verify and correct all information, especially toponyms, which would appear on the community map. Besides the *comi* and the principal local investigators, there were present at the meeting three *ancianos*, a woman and two men. The main result of the meeting was a 50-by-90-cm sketch map of the *núcleo* (Figure 3.1), showing mainly toponyms (*parajes*), rivers and streams, and water sources. To make sure everyone was oriented in the same way, I had drawn on the page only three points (Cerro Mogote, El Arenal, and El Picacho). Accompanying the sketch map, the attendees prepared a list of all toponyms, using what several of them considered to be standardized Zapotec spelling conventions. They also cleared up several misconceptions I had; for example, they sometimes use the word "*cerro*" not in its standard Spanish sense of a peak or mountain, but rather for a pass (i.e., a high point along a road or trail).

Figure 3.1. Talea: Part of participatory sketch map drawn by the author and by a group of villagers in March 2009 (image shown here is reduced from original scale).



In February, Jaime and Maurilio had stated that the most helpful small service I could provide would be to assist them in precisely locating seven key vertices along the boundary between the *núcleo* of San Miguel Talea de Castro and the localidad of Villa Talea de Castro (i.e., the "donut hole" of the *núcleo*). Having acquired the paper PROCEDE maps and coordinate tables from the RAN office, I converted all 150 of the vertices officially defining Talea's boundary from "transverse modified ejidal" (TME) coordinates to UTM, using a software converter provided by RAN. I then entered the UTM coordinates as waypoints in the GPS unit, and explained to Maurilio that they would be stored there for as long as the *núcleo* wished them to be. I then demonstrated to Maurilio how to locate a stored waypoint on the Earth's surface, and together we located the seven vertices in question.

Next, I began to process my data into GIS formats. The major steps were:

1. Using ArcGIS software (versions 9.3 and 10.0), I converted all GPS points into a shapefile, including an attribute field (column) for point-specific field notes.

2. In an "mxd" (GIS project file), I overlaid this with 1:50,000-scale INEGI topographic shapefiles.

3. Using the GPS points, my field sketch maps, and the participatory sketch maps as guides, I began to modify these shapefiles, and to create new ones.

4. I converted the PROCEDE coordinates table for the outer perimeter into to a shapefile of points, and joined these points into a polygon.

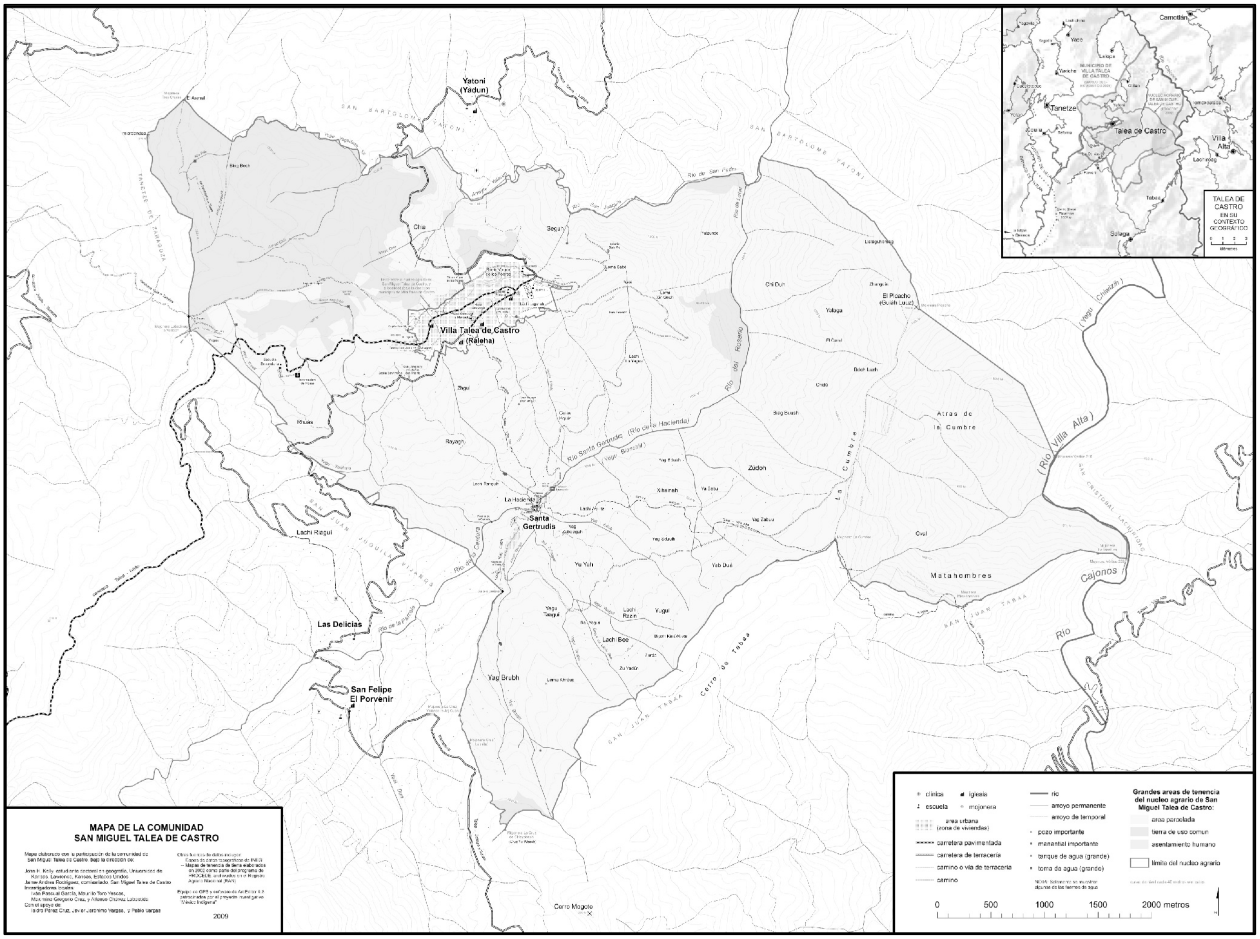
5. I scanned the PROCEDE maps of common use areas and parcels, georeferenced the scanned images using the outer and inner perimeter shapefiles, and created land tenure polygon shapefiles by tracing the georeferenced images.

6. I created the community map (Figures 3.2 and 3.3), with toponym labels, roads, landmarks, legends, and other cartographic elements, and delivered poster-sized copies of it to the *núcleo* authorities during my follow-up visit to Talea in July 2009.

7. I finished the modification and creation of shapefiles based on GPS points, focusing now on information related specifically to the present study: water points, and water conduits. Attribute fields for water points included physical type (i.e., "partly modified small spring"), general purpose ("collection," "storage," or "use"), and user(s). I found it helpful to maintain an "mxd" file which displayed all my collected information, for my own analysis.

After the Talea field data was fully processed into GIS and other digital formats, I repeated essentially the same steps for the other *núcleo*, Yagila, for which I possessed detailed, geolocated land tenure and water information; and then again for Tiltepec, for which I had

Figure 3.2. Talea: Final version of 2009 PRM community map. Actual map is 1:10,000 scale, measures 120 by 90 cm, and is in color.

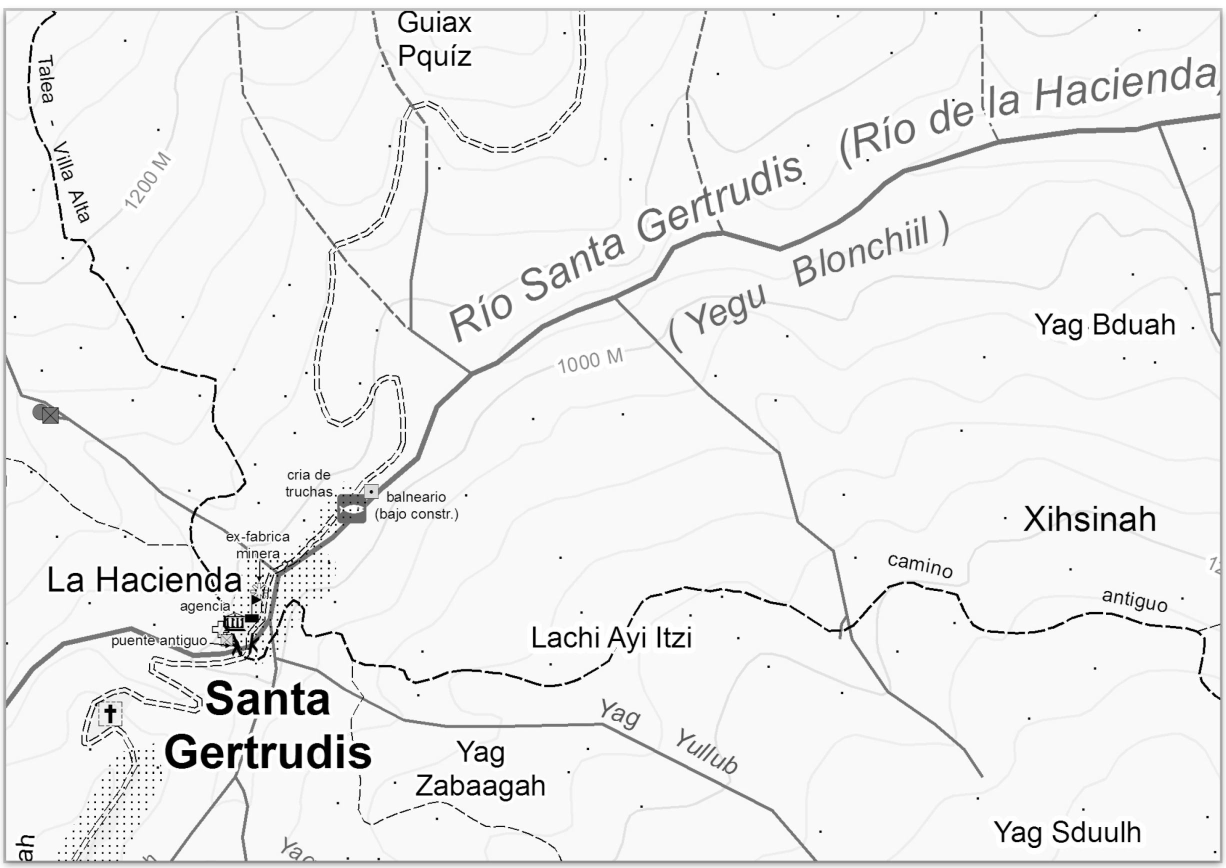


comparable data. Although I had less data for these *núcleos* than for Talea, their processing required special effort, because the data came from various sources: my own fieldwork, and México Indígena results. In Talea, Yagila, and Tiltepec, only a representative sample of water conduits were geolocated, while the sample for water points – especially for important springs – was generally much more complete. Instead of precisely located de jure (PROCEDE-surveyed) internal land tenure areas, these *núcleos* contain incompletely known de facto tenure areas. The GPS locations used to generate the de facto land tenure areas appear in Figure 6.9 (on page 273), and in Figure 6.13 (on page 283). These “fuzzy” polygons were created with the Euclidean

Allocation tool in the ArcGIS Spatial Analyst extension, then displayed as polygons with a gradient fill symbol and multiple offset outlines.

I then repeated several of the same steps once again, for those México Indígena *núcleos* which I revisited briefly in July 2009. I built shapefiles for water points and water conduits, and created "working map" mxd files, with detailed text labels, in order to analyze patterns. Eventually, all water points from all sources were joined into a single shapefile, to facilitate comparison with the INEGI-derived "springs" shapefile which served as the main source for the geodata analysis discussed below.

Figure 3.3. Talea: Detail, at original 1:10,000 scale, of final version of 2009 participatory community map. Original is in color.



3.4 Geodata analysis

The primary goal of the geodata analysis was to broaden the geographic scope of the study beyond the 33 *núcleos* subjected to RAN archival research (and, in 15 of them, to participatory research mapping as well). The study areas are shown in Figures 2.1 through 2.6 (pages 47 to 59), labeled "limit of geodata analysis." "Geodata," in this study, refers to digital spatial data which is acquired mainly through trustworthy secondary sources, quantitatively assessed with the assistance of GIS software, and interpreted through the lens of knowledge gained by archival research and participatory fieldwork.

I chose to focus on a single variable, "important springs," using the *manantiales* (springs) digital data set as it appears on the 1:50,000-scale topographic maps produced by the Mexican federal agency INEGI. In this section, I describe how I developed a land tenure coverage and explored its relationship to the springs coverage. To characterize this relationship, I calculated how many springs would be found in each land use type if they were randomly distributed, and compared this to the observed quantities. (In sub-sections 3.4.1 and 3.4.2 below, I examine the degree to which both of these coverages are accurate and complete.)

The acquisition and processing of the INEGI springs data was straightforward, while the creation of the land tenure coverage was complex. Fortunately, the land tenure coverage construction process served a second purpose. Besides being a required component of the INEGI springs analysis, the land tenure coverage represents an important research result in its own right.

I based the springs density calculations on the total areas of each tenure class within the geodata analysis areas, rather than first aggregating to the intermediate unit of the *núcleo*. *Núcleo*-scale aggregation was unnecessary for my purposes, and would have been impossible to carry out completely in any case, as there is no well-defined equivalent to this unit in private property zones. I also excluded precise population data from the analysis, except to briefly characterize each area's populations for descriptive purposes. Calculating populations within each land tenure type would be a simple exercise, but to compare them would be misleading, since they would simply reflect the arbitrary study area boundaries.

Table 4.1. Land tenure categories used for the geodata analysis. More specific categories are grouped into more general categories adjacent to them; for example, “common use areas” are subdivided into “only only *núcleo* perimeter surveyed,” “common use areas in *comunidades*,” and “common use areas in ejidos.”

<table>
<tr><td rowspan="8">social property</td><td colspan="4">de facto social property,
status as núcleo unresolved</td></tr>
<tr><td colspan="4">núcleos without PROCEDE survey</td></tr>
<tr><td rowspan="6">PROCEDE-surveyed núcleos</td><td colspan="2">only núcleo
perimeter surveyed</td><td rowspan="3">common use areas</td></tr>
<tr><td colspan="2">common use areas
in comunidades</td></tr>
<tr><td colspan="2">common use areas
in ejidos</td></tr>
<tr><td colspan="3">human settlement areas</td></tr>
<tr><td rowspan="2">parceled areas</td><td colspan="2">parceled areas in
comunidades</td></tr>
<tr><td colspan="2">parceled areas
in ejidos</td></tr>
<tr><td colspan="5">non-social property</td></tr>
</table>

In Table 4.1, “parceled” refers to *núcleos*, and areas within *núcleos*, with parcels surveyed and certified by PROCEDE, not to the de facto individual parcels found in nearly every *núcleo* in Mexico. The “common use areas” group category includes *núcleos* where PROCEDE surveyed only the perimeter, in which case the entire *núcleo* is de jure common use, as well as the common use areas that were specifically designated as such within *núcleos* that also contain PROCEDE-surveyed parcels (“common use areas in *ejidos*” and “common use areas in *comunidades*”). “Social property” refers to land within the boundaries of functioning *ejidos* and *comunidades*, ignoring the conceptual argument I discussed in chapter 1 that, in some ways, the very existence of social property terminated with the 1992 land reforms.

The gray portion of each table indicates non-social property. It extends partially into the "parceled areas in *ejidos*" cell, to represent the fact that individual parcels within some *ejidos* (but not *comunidades*) are gradually being transferred into *dominio pleno* (fully privatized properties). As of 2011, the total land area of privatized *ejido* parcels was not large enough to affect the quantitative results,[26] and none of these parcels contained an INEGI-mapped spring.

It is important to note that "civic parcels" – parcels surveyed by PROCEDE, but deeded to the *núcleo*, in some cases to keep a water source or storage facility in the functional equivalent of a common use area – are not differentiated from other individual parcels this analysis. Civic parcels can only be identified within "parceled areas" by soliciting from a RAN office, in person, the PROCEDE maps for each *núcleo* separately. It is possible that some of the INEGI-mapped springs located within PROCEDE-parceled areas are in fact within civic parcels. However, it is unlikely that more than a handful of them actually are so located. One reason I am confident of this is the fact that none of the water-related civic parcels positively identified among the 33 RAN document study *núcleos* contains an INEGI-mapped spring.

The main source used to develop the land tenure coverage for the two geodata analysis areas was a set of spatial data layers called *Acervo* (collection) *de Informacíon Geográfica* (INEGI 2011), offered as a web mapping service (WMS) through an INEGI-maintained web portal called GAIA (formerly Galileo). GAIA allows users to examine many coverages relating to Mexico's human and physical geography as real-time updated links within a personal GIS work file (in ArcGIS, an "mxd"), or to simply use the web portal as a view screen. However, because the coverages cannot be download as shapefiles, in order to use any GIS functions which automate the relating of one coverage to another (e.g., "Select by Location"), or which calculate areas, the user must first laboriously recreate the original digital file. One method to accomplish this is to save a screen shot of one scene, georeference the raster image using some set of features common to a previously acquired shapefile, and build a new shapefile by tracing the georeferenced image, a process sometimes called "heads-up digitizing" to contrast with the now

[26] By mid-2007, over 1.6 million ha had been converted from social property to *dominio pleno* in Mexico, mainly in states bordering the United States (Ventura Patiño 2008, 8). However, from my work analyzing PHINA data throughout the entire Huasteca Potosina region (RAN 2009-12), I know that this has so far only occurred there in a few small, scattered patches, most of them northeast of the Huasteca Potosina geodata analysis area.

little-used method of tracing from paper maps affixed to a digitizing tablet. The process must be repeated for each screenshot (tile).

GAIA presently includes only PROCEDE-surveyed *núcleos*. The layers used for this study were "*núcleos agrarios*," "parceled areas," "common use areas," "human settlement areas," "parcels," and "*solares*." Based on my fieldwork and archival research, I knew that that the layers precisely display the RAN geodatabase of PROCEDE and FANAR data, although without the attribute data (e.g., parcel numbers) found on paper PROCEDE maps and documents. The service provides an excellent overview, at whatever scale the user prefers, of PROCEDE's work in Mexico. I realized how well the system is kept updated when I noticed that one *núcleo* came appeared where none had existed the previous day. A query of PHINA (a database I explain below) confirmed that the *núcleo* had been surveyed and certified by FANAR only a few months previously.

Because it was not necessary to distinguish individual *núcleos*, areas with contiguous *núcleos* of the same type (e.g., "perimeter-only" *núcleos*) could be traced as a single polygon.

The second task was to assign land tenure values non-PROCEDE-surveyed areas. For this, I relied mainly on five sources, detailed below: 1. shapefiles of non-social property from the Mexican federal agency ASERCA; 2. a shapefile of Huasteca *núcleos*; 3. a non-spatial RAN online database on *núcleo* characteristics called PHINA (RAN 2009-12); 4. neighboring properties as shown on *núcleo*-specific RAN maps (including PROCEDE maps); and 5. for a few difficult cases, air photography.

ASERCA (Apoyos y Servicios a la Comercialización Agropecuaria), a unit of the federal agriculture ministry SAGARPA, promotes the development of commerce in agricultural products. I obtained two of their shapefiles (ASERCA 2011) for the state of San Luis Potosí.[27] The first shapefile shows individual private properties; 1,123 are in the Huasteca geodata analysis area. The second shows "*zonas federales*," 77 of which are partly or wholly within the area. Although they lack embedded metadata, the layers are presumed to be reasonably current and complete. After comparing it with neighboring properties as shown on PROCEDE maps I

[27] I obtained the ASERCA shapefiles through my colleage Aida Ramos Viera.

acquired for certain *núcleos*, I found that the private property shapefile undercounted the likely number of private parcels by about 5 percent; I adjusted the area totals accordingly.

The concept of a *zona federal* should not be confused with a *terreno nacional*. The latter concept is an umbrella term with a long and interesting history (Escobar 1999, 16-29), essentially referring to any land that is either considered “empty” (*baldío*) – i.e., not currently owned, occupied, or used by any people, neither by the federal government (*zona federal*), nor by private individuals or corporations (*privada*), nor by *ejidos* or communidades (social). *Terrenos nacionales* also include lands that have not yet been properly surveyed and/or adjudicated (Rojero Díaz 2008, 22), even if they are in fact occupied by residents. Most of the areas I classify as “de facto social property, status as *núcleo* unresolved” are legally *terrenos nacionales*, as are much of the lands within Mexico’s national parks and biosphere reserves. Additionally, some of the land whose tenure status remained unknown after I had exhausted all my sources is likely *terreno nacional*. The *zonas federales* shapefile includes an attribute field “nom_pred” (parcel name). Using these names, the polygons could be classified into the following categories: rivers and large streams; urban areas, including some “county seats” (*cabeceras municipales*) which are also social property *núcleos*; nationalized companies (e.g., railroads, the “Compania Agrícola de México,” or the “Ingenio Alianza Popular”); federal highways; a couple of universities; “*fundos legales*” (an old term for certain human settlement areas); and irrigation districts and “systems.”

Because they relate to water, and because I was uncertain how they should be assigned my land tenure values, I researched the legal tenure status of the irrigation districts. One source (Gómez Morin Rivera 2007), describing the Mexican government’s recent efforts to better survey and catalog government-owned (including para-statal) properties, asserted that irrigation districts (or some of them) are directly owned by the federal government, in the same class as railroads, power-line rights-of-way, and “rivers under investigation.” Other sources, however, including Wilder and Whiteford (2006, 348) and Reyes Hernández and colleagues (2008, 382), led me to the conclusion that the actual land tenure of these districts was more complex and varied.[28] This was confirmed after I used a map in the latter article to create a georeferenced polygon of the Pujal-Coy Irrigation District and compared it to its counterpart in the ASERCA shapefile. It is apparent that irrigation districts are essentially a blend of "redevelopment zones" and "planning zones." In redevelopment zones, private or social property is acquired by the government through eminent domain, and users, typically cattle-ranchers, become leaseholders as irrigation infrastructure is introduced. The land is gradually returned to these users, or to others, after spatial reorganization. In planning zones, government funds are preferentially invested, and lands might be purchased by the government as opportunities arise, but the pre-existing land tenure, including social property, remains unchanged. Thus, the *zonas federales* "irrigation districts" polygons comprise two categories: undisputed social property *núcleos*, and "leftover" lands still owned directly by the government, but leased to, or informally used by, nearby private and social-property ranchers.[29]

The second source used to refine and extend the land tenure coverage was a shapefile of social property *núcleos* in San Luis Potosí state from CONAFOR, the Mexican federal forestry agency.[30] The layer resembles GAIA, but also includes *núcleos* not surveyed by PROCEDE. Comparison with GAIA and with the paper PROCEDE maps showed differences in the alignment of some *núcleo* boundaries, but did demonstrate its overall reliability. This layer showed the spatial extent of non-PROCEDE *núcleos* in the Huasteca study area, something I had to estimate for the Oaxaca study area. The shapefile contains 302 *núcleos* in the Huasteca (GAIA included two more which, for unknown reasons, were not in the shapefile.) With the assistance of colleagues Aida Ramos Viera, Andrew Hilburn, and Gerardo Hernández Cendejas, I had previously entered the PHINA area figures for each *núcleo* and (where applicable) PROCEDE-surveyed *gran área* as attributes. Therefore, I used these more accurate counts for the geodata

[28] Geographer Miguel Aguilar Robledo (1992, 65-66) found that government planners in the 1970s had expected that the final pattern of land tenure in the Pujal-Coy district would be 80 percent social property, but by 1986, as the project began to wind down, the actual social property portion was only 47 percent.

[29] According to Reyes Hernández et al.'s detailed research (2008), the Pujal-Coy Irrigation District boundaries include areas shown as "private properties" in the ASERCA shapefile, but the ASERCA "irrigation district" polygons omit these. This implies that the Mexican government still considers itself the "owner" of social property nucleos in redevelopment/planning zones such as irrigation districts, in ways that it does not consider itself to be owner of any private properties, nor of social properties outside such zones.

[30] This source was donated by an anonymous representative of CONAFOR.

analysis, rather than calculating the polygon areas in ArcGIS, or attempting to recreate the GAIA coverage for sub-*núcleo* tenure areas (*grandes areas*).

The third additional data source was PHINA (Padrón e Historial de *Núcleos Agrarios*), a publicly accessible online archival database maintained by the RAN. Through it, the user may look up any *núcleo* and learn its basic de jure land tenure history and related facts: the dates of official resolutions establishing or significantly changing its extent (including PROCEDE), and the size of the land tenure categories so established. Areas given for pre-PROCEDE-era actions are generally somewhat inaccurate, due to the difficulties of premodern surveying in remote, mountainous terrain. A few *núcleos* appear in PHINA, but not in the other data sets; most of these are listed as having no terrain at all, and may be "paper *núcleos*," i.e. failed attempts at establishing a social property village.

For both study regions, I used PHINA to identify each *núcleo* as a *comunidad* or *ejido*. In Oaxaca, I also used this data source to find *núcleos* never surveyed by PROCEDE, via the following method. I displayed the shapefile of *localidades* (private-property and social-property rural populated places, including village centers and isolated *ranchos*) which serve as census tracts for the INEGI national censuses (Derek Smith and I had built this file from tabular data sets that included latitude and longitude coordinates). For each *localidad* with a population greater than 30 located in territory of uncertain tenure, I searched for its name in the PHINA database. For each such *localidad* found in PHINA, I used its PHINA area figure to construct a polygon of the correct size, using any nearby tenure boundaries derived from other sources, as well as *municipio* boundaries,[31] as guides whenever possible. The resulting polygons represent an educated guess of *núcleo* extents. While certainly not usable for any *núcleo*-scale analysis, this was sufficient to produce the overall area totals of tenure categories, and probably did not lead to my assigning any of the INEGI springs to the wrong category. The exact spatial configuration of 14 of the approximately 313 *núcleos* in the Huasteca Potosina geodata analysis area (4.5 percent), and of 38 of the approximately 146 *núcleos* in the Sierra Norte de Oaxaca

[31] It should be noted that there are numerous inconsistencies between the *municipio* boundaries as shown in the INEGI "*marco geoestadístico*" shapefile, and the PROCEDE-surveyed *núcleo* boundaries depicted in GAIA. In a few cases, the territorial size of an individual *núcleo* as stated in PHINA was much larger than its *municipio* in the INEGI shapefile.

geodata analysis area (26.0 percent) were accordingly estimated because they were never surveyed by PROCEDE or FANAR.

To further improve the land tenure coverage, I examined a fourth additional data source: neighboring properties as indicated by name on any official *núcleo*-scale maps in my possession. The maps included 21 PROCEDE paper maps, three pre-PROCEDE maps acquired by México Indígena, and my sketched renditions of 12 pre-PROCEDE maps encountered during my RAN archival research. While only a minor portion of each study region could be investigated in this way, this task proved invaluable for understanding, through specific examples, the approximate extent and distribution of one category in particular: private properties in the Oaxaca study area.

I am aware of the existence of a limited number of private properties in the Sierra Norte de Oaxaca study area. One in particular had been acquired by a sub-village group of *comuneros* in Teponaxtla, an ancestrally Cuicatec *núcleo* just west of the Oaxaca geodata analysis area (see Figure 7.1 on page 300, where the property is visible northeast of the label "Río Grande"). Referring to the same part of the Sierra, a scholar found that "private properties [*la pequeña propiedad*] that exists today in the Chinantla were formed during the Porfiriato, through adjudications realized via dispossession [*despojos*], invasions, and illegal occupations of communal lands" (de Teresa 1999, 4).

A handful of private properties are former *núcleos* (*comunidades* or *ejidos*) which lost their social property status when a judge declared them to be lacking the required traits of a *núcleo* (in section 5.1, I will recount the example of Yatzona). One Oaxaca *núcleo*, Totontepec Villa de Morelos, was actually surveyed by PROCEDE in 2005, and then declared by a judge to be "*insubsistente*" (null and void) for PROCEDE certification, because its lands were already too privately and individually managed to warrant even the temporary and imperfect social property status which a PROCEDE survey confirms. It is interesting how certain judges, perhaps especially after the 1992 land tenure reforms, are reluctant to acknowledge *núcleo* status to any village where doubts have been raised regarding its eligibility, even if the village is located deep within a mountainous, predominantly indigenous region. I cannot know whether the village of Totontepec "deserved" this legal resolution. In any case, I considered its territory "private" for the purpose of the geodata analysis. I reserved the category "de facto *núcleo*, status unresolved" only for any villages for which I found evidence that it was reasonably likely to eventually be declared a social property *núcleo*.

While the sources referred to above were sufficient to compile an adequate estimate of the total surface area of each land tenure class, and to assign the proper class to most of the INEGI-mapped springs, four of these springs required further investigation, usually because they were located so close to a tenure-class boundary that any spatial inaccuracies could affect their "assignment." For these springs, I used a fifth additional source, air photography, to more accurately locate them in relation to land tenure areas. Eight air photos were acquired from INEGI, while others were accessed through GoogleEarth. Fortunately, the four springs in question were located in parts of the Huasteca Potosina where, based on my field experience, I knew the contrasting land use patterns to be a reasonable (though not definitive) guide to distinguishing private and social properties. (One of these four, the La Cuchilla spring, is discussed in sub-section 7.2.2.) The Chunutzen spring was especially important, for two reasons: it is shown by INEGI as providing water to two nearby *núcleos* (Chunutzen Uno and La Pimienta); and, it is one of the principal sources[32] of the Huichihuayán River, which include K'aan Ja' ("Precious Water"), a Teenek sacred site (Urquijo 2008, 27). The ASERCA shapefile assigned the place to private property, and I did notice an individual farmhouse nearby (with a driveway to the main highway, not linked to any *núcleo*) nearby; but it was difficult to ascertain from the air photograph whether the entire wooded patch containing the spring was part of this property. For methodological consistency, I decided to trust the ASERCA shapefile.

For the INEGI springs coverage, I used shapefiles derived from eleven topographic sheets (INEGI 2000): four in the Huasteca, and seven in Oaxaca, where the geodata analysis area is larger because population density is lower and average *núcleo* territorial size is greater. The Oaxaca coverages were acquired as shapefiles, while the Huasteca coverages had to be converted from Autocad files.

In addition to springs, I processed two other categories of INEGI-mapped water items: water storage tanks ("*tanque de agua*")*,* and water conduits ("*acueducto superficial*" or

[32] The Huichihuayán River emerges from the base of the easternmost major limestone ridge of the Sierra Madre Oriental. Technically, its waters originate from much higher-elevation sources far to the west, and then pass underground through karst pockets.

"*acueducto subterráneo*"). Some of the depicted *acueductos* originate along streams; these are clearly "*tomas de agua,*" and are not given a point symbol in INEGI maps. Water conduits and storage tanks shown on 1:50,000-scale INEGI maps usually indicate village-scale (or larger) systems, mainly for potable ("municipal") water distributed to homes and other buildings in village centers. In regions of Mexico more dependent on irrigation, some INEGI-mapped conduits and tanks are for agricultural use, and some of these are probably individually owned and operated. However, even in well-watered places like Talea, INEGI maps sometimes include water infrastructure operated not by villages, but rather by sub-village groups. The "Río del Rosario" agricultural *sociedad*, a group of Talea *comuneros* (see sub-section 6.1.4), built a pipe to collect water from a stream, and a tank to store the water before distribution to individual parcels. Both the pipe and the tank appear on the INEGI map. The map locates the tank accurately, but it places the *toma* – the other endpoint of the pipe – in the wrong part of the stream. My conjecture is that the tank was visible to INEGI cartographers on air photographs, but that the route of the pipe (which passes through a forested area) had to be estimated, perhaps based on incomplete information from the village itself, or from a CONAGUA permit application.

The most commonly used basic nonparametric test for comparing observed values with a uniform[33] distribution of values among categories is Pearson's Chi-squared test. I chose not to attempt such a precise statistical test, because of the underlying deficiencies in the INEGI springs data set. These deficiencies (explored below, in sub-section 4.4.2) include a lack of independence from the land tenure data set (specifically, a bias toward agricultural areas and, especially, village centers), and a partial dependence on other factors (e.g., geology and hydrology) which can produce unwanted spatial autocorrelation (Slocum 2004, 123).

In both geodata analysis areas combined there were 123 INEGI-mapped springs. Although this number was not high enough to calculate "densities" mathematically (e.g., via quadrat analysis), my quantitative analysis is in essence about "densities" conceptually. Given the number of INEGI-mapped springs, and given the total surface areas of each tenure type, I

[33] Note that "uniform" is not the same as "random." One sense of the latter term is "complete spatial randomness;" that is, "the points follow a homogenous Poisson process over the study area" (Baddeley 2006, 37).

calculated by how many instances (i.e., springs) the expected distribution differed from the observed distribution. For each tenure type, this produced a number, either positive (a "surplus" of springs exists) or negative (a "deficit" of springs exists). Because these raw figures exaggerated the differences for any tenure types with small total areas, I normalized them to n=100. Thus, the tables in chapter 7 show the differences between observed and expected springs as a percentage of the total number of springs.

While not a formal test of statistically significant deviances from expected values, these figures do suggest tentative interpretations when considered together with the other lines of evidence cited throughout this study. One exercise was specifically intended to improve the interpretation of the full-study-area, INEGI-mapped-springs geodata results. I subjected two different data sets representing the same concepts (springs, and land tenure areas) to the same quantitative approach, but at a more detailed scale and produced through different methods. These data sets are the springs and land tenure areas as collected through the participatory mapping work (PRM) in 15 *núcleos*.

Following the main quantitative analyses comparing springs to land tenure types, I performed two briefer exercises, in the same geodata analysis areas, which introduce a third variable: *indigeneity*. I used the same basic analytical approach – expected surface areas (if evenly distributed), compared to observed surface areas – to relate indigeneity first to land tenure, and then to the INEGI-mapped springs. (I discuss the use of "indigenous language speakers" as a proxy variable for "indigeneity" below, in section 3.5.)

3.4.1 Land tenure: Assessing the completeness and accuracy of the GAIA data set

Other scholars have noted the impossibility of acquiring a complete and accurate geodata coverage of all social property in Mexico or one of its regions (Madrid et al. 2009, 182), especially one which includes the extent and location of village lands not officially recognized as *núcleos agrarios* (e.g., by a *Resolución Presidencial*) despite their de facto functioning as commonly-held territories by village-scale groups (Madrid et al. 2009, 184). To evaluate the GAIA land tenure coverage of PROCEDE-certified social property *núcleos*, I compared it to the other sources described in the preceding pages.

In comparing the GAIA data to the paper PROCEDE (and FANAR) maps which I had acquired or viewed for 25 individual *núcleos*, I found only one case where a recently government-surveyed polygon was never uploaded to the GAIA server: the Oaxaca *núcleo* of Tiltepec. In comparing the GAIA data to the PHINA non-spatial tenure histories, I found four other recently surveyed *núcleos* (Comaltepec, Tecocuilco, and Capulalpam in Oaxaca, and Coaquentla in the Huasteca) missing from GAIA (and still not included as of July 25, 2012). These five *núcleos* were surveyed in 2008-2010 by the PROCEDE follow-up program FANAR. Evidently, the GAIA publicly viewable coverage does not include some *ejidos* and *comunidades* surveyed after the end of PROCEDE, even though the legal consequences of FANAR work are identical to any equivalent PROCEDE work.

In the Huasteca Potosina, a few other discrepancies were discovered between the GAIA and PHINA datasets. The *ejido* of El Saucillo was listed as having completed a PROCEDE survey in 2005 (including parcels), but has not appeared in GAIA. Two other *núcleos* appear in GAIA, even though they are listed in PHINA as not having done PROCEDE (or FANAR) work. Finally, two *núcleos* neither in PHINA nor in GAIA were included in the CONAFOR-derived shapefile. These were Tampate and Tamapatz, the two large, water-source-rich villages whose status as a *núcleos* is disputed and unresolved.

To summarize, no one source is perfect, but omissions or errors in any one source are usually answered in another source. It is possible that a handful of *núcleos* are misattributed in the final land tenure coverage, but it is extremely unlikely that these add up to even as much as five percent of the total area.

I reiterate that none of the land tenure sources capture the distinction between de facto common use and de facto individually parceled areas, only between their de jure, PROCEDE-surveyed counterparts. For this geodata analysis, all land within *núcleos* either never surveyed by PROCEDE, or with only a perimeter was surveyed by PROCEDE, is counted as "common use." For the de facto tenure distinctions within such communities, I collected reliable data in only four *núcleos* (Tancuime, Cuatlamayán, Tiltepec, and Yagila). Of these, this data was complete enough for quantitative analysis only in two *núcleos* (Tiltepec and Yagila).

3.4.2 Springs: Evaluating the criteria for inclusion in the INEGI data set

To try to ascertain what the INEGI 1:50,000-scale “springs” coverage represents, I examined three sources: INEGI cartography user manuals; important springs mapped through participatory fieldwork; and air photography which I had interpreted to explore relationships between springs and forested areas. My conclusion is that some bias exists in the INEGI springs coverage toward areas with more direct and intense human use and occupation.

I read three INEGI user manuals: a guide to their “potential land use” maps, which use the same “springs” layers as their topographic maps of the same scales (INEGI 1996, 67); a data dictionary” for their “subterranean waters” maps, which also use the same “springs” layer, though with added hydrological data for many of these springs (INEGI 1997a, 11-12); and a guide to “air photo interpretation,” to assist users in reading the same publicly obtainable 1:10,000-scale air photographs which INEGI cartographers use to develop much of the information on their topographic maps (INEGI 2005a, 13). The last document stated directly that springs were located using air photographs, and that this was especially useful for two purposes: understanding geology, and locating suitable sites for cattle ranching. The first document considered a “spring” to be a “water supply feature,” which is a type of “public service.”

Maps developed through participatory fieldwork, generally suited to about 1:10,000 scale, naturally include more springs than 1:50,000-scale topographic maps. In all the fourteen PRM *núcleos*[34] (12 mapped with México Indígena, plus two with CAPLAC), only four springs appear on the INEGI maps. One is in the CAPLAC *núcleo* of Buenavista; another is within the perimeter of Tiltepec – although not in the part mapped participatively, but rather in the part occupied by the non-participating village of La Luz; a third is in Tancuime; and a fourth is in Chuchupe. In these same 14 PRM *núcleos*, 144 springs were mapped through participatory methods. According to these samples, the INEGI inclusion rate for springs deemed important by communities is 2.8 percent.

This figure, while perhaps interesting, does not tell us anything about what kinds of springs INEGI tends to include. While maintaining caution due to the very small sample size, I

[34] For this exercise, I did not include Talea, because my fieldwork there was directed specifically at springs, and thus includes a different level of detail than in the other PRM nucleos.

began to probe this matter by isolating just those three *núcleos* where I had already made forest cover maps from air photographs (Tancuime, Cuatlamayán, and Chimalaco). There was one INEGI-mapped spring within them, in Tancuime. 62 percent of the 52 PRM-mapped springs in these three *núcleos* were located in forests, yet the one INEGI-mapped spring was located in a *non*-forested patch. It seems that INEGI mainly maps springs that are visible in air photographs, perhaps supplemented by some information provided by municipal (county), state, or federal agencies. Whether by accident or by design, in a region with large and numerous forest patches, this results in a coverage with a bias toward open-field agricultural areas and certain village centers. In social property *núcleos*, such areas tend to be imperfectly correlated with parceled areas and human settlement areas, whether de facto or de jure.

Because it exemplifies the same social construction of nature which pervades all aspects of the present study, this apparent bias toward water sources in high-human-activity areas is not worrisome. The only problem is that my INEGI-based analysis may have failed to include a representative sample of springs which are invisible in air photographs due to forest cover, yet which are nonetheless so important to humans (e.g., as sources for a village potable water supply). Again, this problem is potentially most relevant when considering common use areas in *núcleos* which also contain PROCEDE-surveyed parcels. I investigate the issue further in sub-section 7.4.2.

3.5 Supplementary work

Three additional principal sources of information were: 1. interviews with officials or local residents in places other than Talea; 2. three digital files of CONAGUA water concessions in the Oaxaca geodata analysis area, and 3. miscellaneous mapping work.

Interviews were unstructured discussions, focused on the specific questions at hand but often evolving to include unanticipated ideas and advice from the interviewee. The conversations with *ejidatarios* and *comuneros* were especially important for improving my understanding of de facto (i.e., non-PROCEDE-certified) land tenure practices.

In the state RAN offices, I talked with José Manuel Vásquez Córdova, Secretary for the Delegation (*delegado*) of RAN in Oaxaca, and José Ledezma Barragán, his counterpart in San Luis Potosí. At the CONAGUA Pacífico Sur Watershed office in Oaxaca, I met with Pedro Bernal Flores, chief of user services at the Dirección de Administración del Agua, and with his colleague Vicky Díaz Jiménez, who also provided me with copies of the federal water laws, regulations, and rights (CONAGUA 2008b; CONAGUA 2008c). At the CONAGUA Golfo Central Watershed office in Xalapa, Veracruz, I talked to Mario Guillermo Yáñez Morales.

In *núcleos* in the Huasteca, I held discussions with Agustín Lázaro Reyes, Dario Hernández Reyes, †Daniel López, †Claudio Salazar (*Presidente del Comisariado Ejidal* of Chimalaco), and †Andrés Almendro. In *núcleos* in Oaxaca (besides Talea, described in section 4.3), I talked with Raymundo Ramos Francisco (former *Presidente del Comisariado de Bienes Comunales* of Yagila) and Flavio Pérez (*Presidente del Comisariado de Bienes Comunales* of Totomoxtla).

Nearly all of the Sierra Norte de Oaxaca geodata analysis area lies within the major watershed administered by CONAGUA through its office in Xalapa, Veracruz. There I was given two digital files (CONAGUA 2009) which list the water concession titles currently in force within the sub-watersheds which comprise most of the Oaxaca geodata analysis area, with attribute columns such as their locations in latitude and longitude, the name of the water source, the volumes of water conceded, and the type of user. I also obtained INEGI-produced shapefiles (described in INEGI 2009), for both Oaxaca and the Huasteca, which contain some water sources (and, for many of them, attribute data such as concentrations of anions or cations for various compounds) not included in the INEGI 1: 50,000-scale topographic maps. I used these data sources to create Figure 7.6 (page 337).

In chapter 1 (Introduction) and chapter 2 (Study Areas), I provided some explanation for how I made the maps which appear in those chapters. I conclude this chapter with a more details on the process of making several of those maps.

For maps which show indigenous language areas, I calculated “percentage of population age 5 or older who speak an indigenous language,” derived from the 2005 census and joined to an INEGI *localidad* shapefile. Kemper and Adkins (2004) found this method to be imperfect but adequate. In late 2011, after I had completed this work, INEGI released its tables from the 2010 census. For the first time, the census included questions about ethnic self-description (CESOP 2011, 4). This contributed to a 75 percent increase in Mexico's indigenous population between 2000 and 2010. While it is likely that a few of the observations in the present study would be modified by including self-reported ethnicity figures, the overwhelming impact of the new census method has been in urban places, not in the rural areas which are its focus (CESOP 2011, 7).

I displayed the *localidades* points as three classes, based on natural breaks observed in the histogram (Kelly et al. 2010, 171). *Localidades* with greater than 62 percent indigenous language speakers were considered "indigenous," those with fewer than 13 percent were considered "non-indigenous," and those in between were considered "mixed." I then drew polygons around the populated areas, assigning to each polygon whichever class of *localidades* had a visual preponderance. Relatively large, contiguous areas more than about 4 km from villages (here defined as *localidades* with more than 100 inhabitants), or more than about 1 km from *ranchos* and other very low-population *localidades,* were designated as "no population." (Note that "no population" does *not* imply "unoccupied," nor "unused by any local resident," nor "not owned by any person or *núcleo*," but rather an absence or near-absence of permanent homes.)

I then mapped specific languages by using *municipio* (county) level data from the 2005 census. I displayed each language in turn as a percentage of total indigenous-language speakers, and drew boundaries (with a buffer of about 5 km) around *municipios* where the language was spoken by a plurality of them. I made adjustments for those parts of large *municipios* without significant indigenous speakers, as well as for "no population" areas. Because each language is assigned a separate attribute field in the shapefile, overlap zones are possible, such as the parts of the Huasteca (e.g., the México Indígena-researched *ejido* of Las Armas) where both Teenek and Nahuatl are widely spoken.

Finally, air photographs were used at several points during the research: to locate forest cover in four *núcleos*; to better understand land use patterns in *núcleos* including Santa Cruz and La Pila; to improve the vegetation and land cover coverages for the maps in chapter 2; and to complete the land use and land cover map of Talea (Figure 2.7, on page 65).

I developed Figure 2.7 by combining INEGI topographic shapefiles, digitized PROCEDE maps, and PRM-derived features such as local toponyms. To this I added a land use/land cover (LULC) coverage, created via remote sensing interpretation in the following manner:

1. I converted my 203 GPS field points into a shapefile, and assign to each of them a class from the following list: agriculture, pasture, orchard, coffee, secondary vegetation, humid pine-oak forest, logged clearing in forest, humid tropical forest, cloud forest, and natural dry-climate vegetation.
2. I acquired high-resolution true-color air photography. Fortunately, GoogleEarth has just recently made this available without cost. However, the imagery did have about 25 percent cloud cover. For these areas, I substituted lower-resolution true-color GoogleEarth satellite imagery.
3. I created an LULC polygon shapefile by visually interpreting the imagery with reference to the field points. The most challenging class proved to be (shade-grown) "coffee," as it often resembles other classes (e.g., humid pine-oak forest, orchard, or secondary forest), but I found the final result to be satisfactory, based on my knowledge of the *núcleo*.

Finally, I executed a modest, preliminary investigation of state-sanctioned "natural protected areas" in the geodata analysis areas using shapefiles acquired from CONANP, Mexico's federal commission on protected areas (CONANP 2011). One shapefile comprises 778 polygons representing approximately 200 federal natural protected areas, including marine reserves. The other, perhaps an incomplete data set, represents state-level natural protected areas in Mexico large enough to be represented as polygons on 1:250,000-scale maps.

4. Related scholarship

In this chapter I will present a deeper introduction to the main concepts involved in this study, especially as they apply to Mexico: land tenure, neoliberalism, water source proprietorship, and indigenous perspectives on these themes. This is not a comprehensive literature review of these concepts. Rather, it is a selective introduction to certain theoretical, empirical, and case-study sources surrounding these concepts, many of them specific to Mexico. As a whole, the body of cited works is suffused with reference to three kinds of actors (the individual, the village, and the state), two material geographic features (land and water), and two modes of normativity (de jure "law," and de facto "practice"). Secondary sources related to the method of participatory research mapping (PRM) were reviewed in chapter 3.

4.1 Land tenure and neoliberal reforms

Land tenure has long been a favorite subject of many cultural geographers, as well as of some anthropologists, political scientists, sociologists, historians, philosophers, and legal scholars. Because it is a universally relevant and contentious concept which links the spatial geometry of the earth's surface with the cognition and organization of human beings, Nicholas Blomley has called on geographers to focus more deeply on the subject of property, and to include concepts beyond the standard one of "territorialized, discrete space" owned by a private citizen and endorsed by the state (Blomley 2005, 126). "As has been mentioned by many authors but cannot be stressed too often, 'property is not a relation between people and things, but between people with respect to things'" (Nuijten, Lorenzo, and de Vries 2006, 17). In geography, influential works about territoriality, ethnic communities, and sovereignty within jurisdictional or administrative areas include Sack (1986), Delaney (2005), and, among the early cultural ecologists, Brookfield (1964).

Neoliberalism has been defined as "a theory of political economic practices that proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an institutional framework characterized by strong private property rights, free markets, and free trade," in which "the role of the state is to create and preserve an institutional framework appropriate to such practices" (Harvey 2005, 3). Neoliberalist policies are simultaneously enacted through the existing system of state (national) governments – often in response to pressures imposed by a "consensus" within international financial institutions – and, in theory, with the goal of removing the state from many of its responsibilities. It is a central concept within current discussions regarding *governance*, whether narrowly defined as simply the legitimacy, competence, and real power exercised by national, provincial, or county-level government bureaucracies, or more broadly defined as "the emergence of actors who do not belong to the traditional governmental sphere, but still play a part in the control of public affairs and establish complex (antagonistic, complementary, or juxtapositional) relationships with the state" (Blundo and Le Meur 2009, 2).

Many question whether neoliberalism is as encouraging of democracy as its advocates claim; indeed, geographer David Harvey has called it "profoundly anti-democratic" (Harvey 2005, 71), because it has empirically been shown to accelerate the accumulation of wealth by an entrenched elite, and because it leaves many socially sustaining functions in the hands of less-accountable corporations and NGOs. Other frequent topics of debate include the extent to which neoliberal policies favor the individual over the group, and to what degree it causes the commercial market to dominate over alternative spheres of reproduction and exchange. In the specific realm of land tenure, for example, many governments have enacted programs to standardize, modernize, and complete their cadastral information systems, often entailing a reform of land tenure laws and legal procedures (Powelson 1988). While this certainly can be one step in the information availability, commodity interchangeability, and legal security demanded by neoliberal advocates, such land tenure standardization need not inherently require the elimination of non-individual or non-commercial social structures, at least not directly or immediately, such as is the case in Peru.

Arturo Warman (1937-2003) was an architect of the 1990s land tenure counter-reform in Mexico, a component of neoliberalism. Warman was an anthropologist who directed Mexican government's National Indigenous Institute (INI, now CDI) early in the Salinas administration, and then the Agrarian Reform Ministry (which oversees the National Agrarian Registry, or RAN, in essence Mexico's social property cadastre and legal forum) until 1999. While some find it ironic that an advocate for the indigenous would sow the seeds for the eventual dismantling of the post-Revolution social property system, Warman did not find this to be a contradiction. In his mind, the corrupt, effectively one-party state was so entrenched in that system, that only the neoliberal promise (in theory) of a reduction in the role of the state could free rural individuals *and* communities, including indigenous ones, from fulfilling their potential – even if in practice this might necessitate deeper state involvement in the organization of some productive activities in indigenous regions (Hernández-Díaz 2001, 37). Warman did not believe this would require the elimination of the *ejido* as an institution, but he did recommend (1972, 101) that the village should no longer be sacrosanct as the locus of identity and local power, because villages so often fought with each other, and were themselves dominated by local corruption and false democracy:

> Thus, the peasant corporation which owns the land lives isolated in a hostile environment, surrounded by real or potential enemies with whom neither alliance nor cooperation is possible. Their fellow peasants constitute a permanent threat. The power or force of each isolated unit is small, ridiculously small if it is confronted with the potential might of the provincial city, acting as the seat of economic and political power.

4.1.1 Land tenure law

Many theorists do not see a fundamental difference between land and natural resources such as water or trees; land is a resource like any other. In this sense, considering land to be something which one owns outright, and other resources as things which one merely has *rights* to, is a misleading distinction. In all cases, “we don’t really own resources; rather, we own the property rights that we attach to those resources” (Sekar 2003, 269). The nature of the owners of these rights – individuals, village-sized groups, corporations, or the state – determines the kind of common or private property involved, rather than the nature of the thing we attach the rights to.

All of the classes of property include restraints imposed by law and by society on these rights; even private property rights merely grant an “individual or family with the right to control access and to use resource in socially acceptable ways, and duty to avoid other uses.” Non-private property can be of several different types, including “public lands with open access,” where “no one owns the resource”; “state (government) property,” where the “owner is all citizens (as represented in government bodies), with right to determine rules, and duty to maintain social objectives," and finally true "common property," where the "owner is a well-defined collective, with right to exclude non-users, and duty to maintain resource, partly by containing its rate of use" (Sekar 2003, 270). Only the first of these, open-access public lands, is necessarily susceptible to the famous "tragedy of the commons." Even the term's inventor Garrett Hardin "later admitted [that] the 'tragedy of the commons' is a misnomer. Common-pool resources are usually governed by rules and social relations that control access with the goal of limiting overuse. Where it occurs, Hardin's tragedy is, rather, a tragedy of open access, in which no property-rights systems are in place" (Bakker 2010a, 172; see also Ashenafi and Leader-Williams 2005, 549).

Mexico's social property system is (or at least was) an example of the last of these types, true "common property." Much of the system's economic, environmental, and cultural success requires that ownership, management, and access be maintained, to some practicable degree, at the same scale of human grouping – in this case, that of the village (Hanna and Munasinghe 1996). However, the individual is still important:

> The essential element in the term CPR [common property regime] is the combination of collective ownership of the resource system (the productive stocks, the commons, the ecosystem that yields product) with individual ownership of rights to appropriate and often to sell that system's annual harvest or flow, as attenuated by the regulations invented and enforced by the collectivity that owns rights to the productive system.
> (Sekar 2003, 271)

In Mexico's social property system, another layer of complexity arises from the *jurisdictional* spatial unit generally coinciding with the land area which is owned in common. That is, the *núcleo* assembly is both responsible for making and enforcing local laws within its territory – laws which also apply to women, children, non-landowning *pobladores*, and recently fully privatized ex-members – and for exercising collective ownership of that territory. In post-1992 PROCEDE-parceled *núcleos*, this collective ownership is fully intact only within the remaining de jure common use areas.

Whether considered in jurisdictional or in property ownership terms, the extent of a *núcleo*'s territory is not necessarily tied to its legal description in state-sanctioned documents. In his study of two feuding *núcleos* in the Central Valley of Oaxaca, Phillip Dennis (1987, 163) found that:

> One of the most fascinating bits of evidence, to me, of the persistent nature of these [foundation] stories (and of village land claims) was the recital by informants of the boundary markers 'as they should be', not as they are legally recognized. I noted that there were at least two different cognitive maps of the lands – the one held by Zautla and the one held by Mazaltepec – in addition to the version marked by government authorities as official on both villagers' paper maps. The 'true' cognitive map of the community lands is preserved long after the official map has changed, indicating the tenacity of village land claims. Given the moral basis of village land claims, definitive settlements and Presidential Resolutions do not change the conviction of ownership on the losing side.

4.1.2 Neoliberalism

There has been "an emphatic turn towards neoliberalism in political-economic practices and thinking since the 1970s" (Harvey 2005, 3). The implementation of neoliberal tenets at a national scale began with Chile, where economists who had studied under the University of Chicago's Milton Friedman worked for Pinochet's government with the assistance of the International Monetary Fund (Harvey 2005, 5), reversing the previous land reform which had established a system of *asentamientos* (cooperative groups) (Dorner 1992, 38). Global economic crises such as the 1973 Arab-nations oil embargo exacerbated tensions between the essentially Keynesian relationships among states and economies, and the need for more flexible flow within the integrating markets of labor, capital, and goods (Judt 2010). The neoliberalist response to this tension was advanced in successive stages, reaching Mexico first in the wake of the 1982 debt crisis, which had been caused by a combination of high global interest rates promoted by United States Federal Reserve chairman Paul Volcker to combat inflation, and a fall in the price of oil on which the Mexican government had recently become overdependent (Meyer, Sherman, and Deeds 2003, 719). The Reagan administration and the IMF insisted that privatization of state assets be a condition of any rescue package (Harvey 2005, 11):

> In 1984 the World Bank, for the first time in its history, granted a loan to a country in return for structural neoliberal reforms. [President] de la Madrid then opened Mexico to the global economy by joining GATT and implementing an austerity programme.

> The effects were wrenching: from 1983 to 1988 Mexico's per capita income fell at a rate of 5 percent per year; the value of workers' real wages fell between 40 percent and 50 percent.

The privatization process in Mexico came to fruition during the heyday of neoliberal reform, during the administration of Carlos Salinas de Gortari (1988-1994), as the demise of the Soviet Union signaled the apparent victory of unfettered capitalism over state control of resources. Emblematic of the winners of privatization was Carlos Slim, the Mexican telecommunications magnate who is today one of the world's wealthiest persons – in the words of David Harvey, "neoliberalization has not been very effective in revitalizing global capital accumulation, but it has succeeded remarkably well in restoring, or in some instances (as in Russia and China) creating, the power of an economic elite" (Harvey 2005, 8). The Salinas administration made parallel commitments to free trade, including the elimination of subsidized foodstuffs, and to the modernizing – and, arguably, to the elimination – of the rural social property system. Although neoliberalists assured that democratic reforms were an inevitable part of their plan, one-party dominance persisted in Mexico, as it did even more rigidly in an ever-more capitalistic China. The fierce reaction in Mexico against the state, led by the Zapatista rebellion of 1994, was directed against neoliberal policies and against the continued top-down paternalism of the PRI, Mexico's ruling party at the federal level since the 1920s. Under the Ernesto Zedillo administration – the PRI's last,[35] until 2012 – the country suffered yet another debt crisis in 1995, while ex-President Salinas was suspected of massive corruption, for which his brother Raúl was indicted.

While the PRI regime's loss in the 2000 elections finally heralded a new (if incomplete) flowering of democracy in Mexico (Preston and Dillon 2005), the government's policies and

[35] A recent paper (de Janvry, Gonzalez-Navarro, and Sadoulet 2011) explains how benefactors of Mexico's neoliberal land tenure reform failed to credit the PRI for the change in their favor. Another analyst describes how the the state-initiated neoliberal turn in Mexico coincided with accelerated movement toward fuller democracy, as well as a global reawakening of indigenous rights issues; all three trends were simultaneously aspects of, and reactions to, each other (Olvera 2010, 83). The interplay among these trends and partially opposing forces is complex. It includes the PRI's (temporarily) unsuccessful attempt to try something new to hold onto the power that was finally slipping from its grasp, as well as the leftist reaction (sometimes in alliance with with some indigenous peoples) to NAFTA, PROCEDE, and the commercialized, "placeless" ethos they represent to many.

practices hardly changed. This was due in part to President Vicente Fox and his successor Felipe Calderón being of the center-right PAN party, leaving Mexico an exception among the "center-left coalitions, openly critical of neoliberalization, [who] have taken over political power, and seem poised to deepen and extend their influence all over Latin America" (Harvey 2005, 64), Furthermore, rather than responding to leftist and indigenous dissatisfaction, Mexico since 2000 has had to focus its attentions to the economic stagnation engendered by its deep ties to the ailing United States economy, as well as to the crisis of governance exposed by a US-encouraged attack on drug trafficking cartels (Longmire 2011).

The 1990s neoliberalist-directed land reform in Mexico is in a narrowest sense simply a tool, the application of updated surveying and data storage technologies to the problem of a complex and confusing palimpsest of tenure regimes.[36] However, as the great historian Fernand Braudel cautioned, "one must always take account of history, or perhaps one should say society, in the broad sense; technology is never the only factor in the discussion" (Braudel 1979, 335). As David Harvey reminds us, "neoliberalization has transformed the positionality of labor, of women, and of indigenous groups in the social order by emphasizing that labor is a commodity like any other" (2005, 59). To the extent that rural, village-based societies – especially, perhaps, indigenous ones – connect their practices (including labor) to the specifics of place, they may be especially affected by, and in turn they may be especially capable of transforming, the elements of neoliberalist practices by which the state promotes the increasing commodification of land and natural resources (see, e.g., Stocks 2005). Karl Polanyi (1944, 79) wrote that:

> To allow the market mechanism to be sole director of the fate of human beings[37] and their natural environment, indeed, even of the amount and use of purchasing power, would result in the demolition of society. […] Robbed of the protective covering of cultural institutions, human beings would perish from the effects of social exposure; they would die as victims of acute social dislocation through vice, perversion, crime and starvation. Nature would be reduced to its elements, neighborhoods and landscapes defiled, rivers polluted, military safety jeopardized, the power to produce food and raw materials destroyed.

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[36] In their review of cadastral mapping as it developed in the service of European states, Roger Kain and Elizabeth Baigent (1992, 336) affirm that "the collecting of taxes and state revenues from land and resources drawn from that land, has been the overwhelming reason" for the growing practice.

[37] Mike Davis (2004, 54) criticizes Polanyi for reifying the "market" as some automaton, rather than something humans make.

Harvey (2005, 80) contends that "neoliberal concern for the individual trumps any social democratic concern for equality, democracy, and social solidarities." While this may overstate the opposition of neoliberalism to democracy as it has actually been implemented, it is difficult to exaggerate the degree to which neoliberalism has failed to keep its promise of reducing the presence of the state in those realms where the powerful deem state intervention to be advantageous (Watts 1994, 380). "As [Béatrice] Hibou suggested (1999), rather than the decline of its structures, the apparent retreat of the state under the privatization policies may mean its redeployment in other forms. According to this hypothesis, the state would retain a certain level of control over society, relying on private intermediaries, as indirect colonial rule had done" (Blundo and Le Meur 2009, 17). Because many indigenous peoples define themselves partly by their resistance to the state, which was constructed mainly by others on territory their ancestors had already occupied (Metz 2006, 5; Cobo 1986, 4), indigenous societies play a unique role in shaping the evolution of land tenure practices and natural resource stewardship.

4.1.3 Neoliberal land tenure reforms in countries other than Mexico

Numerous studies document the effects of recent land reform programs in developing countries (e.g., Thiesenhausen 1995; Wolford 2003 and 2007; Bobrow-Strain 2004). In Mexico there is a clear distinction between the post-Revolution social property land redistribution and the post-1992 neoliberal-influenced counter-reform. The onset if the two eras are separated by about 70 years, so the redistribution program had time to deeply influence a huge portion of the country. In certain other countries, the two eras occurred much closer in time. For example, Peru enacted a reform in 1974 to allow community titling among indigenous peoples (Plant and Hvalkof 2001, 15), only about 20 years before the neoliberal reforms I review below. In other countries "socially progressive land redistribution or community-scale rights" and "neoliberal-influenced land tenure reform" are enacted simultaneously, often under the banner of cadastre standardization. In Ecuador, for example, "in the 1990s the demarcation, registration, and titling of small rural landholdings were re-organized around the contradictory impulses of ethnic rights activism, neoliberalism, and the rise of geographic information systems" (Radcliffe 2009, 439).

In any country, unique historical circumstances shape the form and implementation of its state-driven land tenure plans. One common variant, e.g. in Guatemala and Colombia, is the resettlement of internally displaced civil war refugees, usually disproportionally represented by indigenous people; another variant is the state-encouraged settlement of a vast forest frontier, as in Amazonia, where Brazil is trying to systematize its cadastre, but deliberately keeping some aspects of it ambiguous while "condoning violence as a means to acquire and protect property rights" (Simmons et al. 2007, 578; Blomley 2003, 122).

To represent the range of studies, I will mention just two: one from South Africa, the other from Peru.

Wiebe Nauta (2009) related how it became necessary to address the imbalance of land ownership, as the apartheid system was terminated and the former "Bantustans" (nominally autonomous, crowded regions where blacks had been forcibly resettled) were re-incorporated into South Africa. The last white-dominated administration under DeKlerk ensured that land reform would favor private property rights, as "the rhetoric of the market also penetrated the Land Reform Programme that was drawn up after the first democratic elections" (243). While this was done mainly to protect the interests of white landowners, it also coincided with the widespread neoliberal ethos of policymakers in the early 1990s.

The program which resulted also included a social property tool reminiscent of post-Revolutionary Mexico: the "Communal Property Association" (CPA). In Mexico, *ejidatarios* were given land carved from expropriated *haciendas* outright. In South Africa, landless blacks were given cash grants to purchase properties at market value, which they often could only afford to do by organizing village-scale groups. Unfortunately, building a workable village-scale culture from the ground up often failed: "CPAs ultimately proved to be a problematic answer as group ownership and management created severe difficulties in 'communities'" (Nauta 2009, 244). Without a history of group cohesion, and in many cases lacking strong leadership, many individuals feared that they were contributing more than their fair share to farming tasks. In a small women's cooperative, for example, Nauta (2009, 258) found that:

> There was an obvious tension between the private and the common domain that led to distrust and tensions. The number one priority for every household is to get its own garden ploughed and only then can people begin to think about common agricultural

> goals. But even these goals are subordinate to private goals like sending children to school and clothing them.

Monique Nuijten, David Lorenzo, and Pieter de Vries described the case of Peru, where a new 1993 Constitution, and a 1995 land law, "opened the way to the privatization of communal land rights" (Nuijten, Lorenzo, and de Vries 2006, 4). However, as in Colombia (Ng'weno 2000), the neoliberal-hued land tenure program has also provided village-scale groups to codify their land tenure regimes, somewhat in the style 20th-century Mexican social property *núcleos*. In other words, Peru's efforts have been directed primarily at standardizing a rational, complete national cadastre, but not necessarily, in many cases, about privileging the individual.[38] Like their indigenous Mexican counterparts, many Andean peasant communities chose to only have their community perimeters surveyed and certified.

Nuijten, Lorenzo, and de Vries stress that these village-oriented legal cadastral forms can be just as neglectful of complex local tenure practices as the privatizing of individual parcels would be. They see that the Peruvian government, and the NGOs which advise it, are beholden to a romanticized, simplified "culturalist notion of the Andean *comunidad*," where straightforwardly communal land tenure practices are erroneously assumed to be "the original expression of deep Andean values." Instead, "contrary to the popular image conveyed by government officials, academics and Usibambinos themselves, the *comuneros* do not have an exceptional inclination towards equality and communitarian ideology" (Nuijten, Lorenzo, and de Vries 2006, 17). The state's essentializing of village society has at least two negative consequences. First, it colors any intra-village squabbling as a failure, rather than as the negotiated, evolving manner through which villagers have always engaged each other. Second, it can encourage the "exclusion of specific groups, [and] domination by others" (Nuijten, Lorenzo, and de Vries 2006, 4) by rigidly legalizing the property rights of "haves" (the Peruvian equivalents of *ejidatarios* and *comuneros*) and "have-nots" (other residents of the same communities).

[38] In this respect, Mexico and, to an even greater degree Peru, arguably seem generally to be adhering to Article 17 of the UN Universal Declaration of Human Rights (1948), which "provides for the right to own collective property and not be arbitrarily deprived of that property" (Posey 1994, 228).

4.2 Water source control and land ownership

Among geographers and other social scientists, relationships among people, land, and natural resources have been matters for analyses often grouped under the term "cultural ecology" (e.g., Vayda 1983), as well as the more recent variant "political ecology." The latter approach includes geographer Erik Swyngedouw's work on the "continuing centrality of the state and of 'governance' in the regulation of the water sector, and the weakened position of the citizen vis-à-vis these modes of water governance" (2003a, 10) and Tina Wallace and Ann Coles' edited volume on water, gender, and development (2005). A related field is "environmental history," where scholarship on land and water in Mexico includes works by Butzer and Butzer (1993), Melville (1994), and Endfield and O'Hara (1997). Environmental historian Ted Steinberg (1995, 98-103) discussed the legal and practical difficulties of attaching water ownership to landed property.

In the Mexican Constitution, water is considered as fundamentally belonging to the nation as a whole in certain ways that do not apply to the ownership of land. This distinction is a specific example of a general one between land and natural resources, one which takes different legal and practical forms in different countries. In many contexts it is more accurate to use words such as "proprietorship," "management," "custody," "control," "supervision," or "caretaking" to describe the rights specific people or groups have with regard to specific water sources, water bodies, or volumes of water.

David Harvey (2005, 3) asserted that a goal of neoliberalism is that "if markets do not exist (in areas such as land, water, education, health care, social security, or environmental pollution) then they must be created, by state action if necessary." Karen Bakker, in *Privatizing Water: Governance Failure and the World's Urban Water Crisis* (2010, 191-192), makes a more detailed and nuanced argument that acknowledges the complexities involved in the physical qualities of water, as well as in the varied forms of "privatization" and the specific, limited situations (usually, engineered potable water systems in cities)[39] in which it is accurate to speak of a water "market":

> On one hand, we need to view water as a flow resource (including sanitation, which is strangely absent from much of this debate) – a part of the hydrological cycle. On the other hand, a relational approach suggests that water is articulated with other social relations such as property: land use and water use are inextricably interlinked, in both cities and rural areas [. . .] The link between people and urban property (e.g., via tenure) is central to explaining urban water-use practices. This implies that an explanation of the social construction of urban water-use practices must articulate the relationship between land and water, and between the social relations that govern these resources (such as land tenure and water rights).

Bakker implies (2010a, 199-200) that geographers, being trained to integrate understanding at multiple spatial scales, are especially qualified to offer insight into issues of water rights and proprietorship:

> Water is a flow resource which transcends boundaries; its positive and negative effects are felt far downstream. Yet water is used locally: cheap to store but heavy and thus costly to transport, water is most often used close to the point of abstraction. As a result, water creates a tension between the local scale and higher scales of governance. [. . .] As a flow resource, water is, moreover, the supreme integrator; given water's ability to dilute and transport pollutants (sometimes over long time scales), the nature of water use by one user on another is often difficult to discern. [. . .] This framing provides insight into potential solutions to a particularly intractable question within privatization debates: the issue of scale, so central to the tension between community and corporate systems. [. . .] Water is biophysically multiscalar, but it is used and disposed of locally.

Water is neither an entirely private nor entirely public good (Myers 2010); "its status is irrevocably ambiguous" (Bakker 2010a, 207). Corporate control often dominates when the infrastructure for a water storage and conveyance system is massive, and this is where arguments about the role of the state are most germane. In contrast, relatively "artisanal" small-scale water systems "are more often directly controlled by communities; tend to be in rural or peri-urban areas; and in rural areas, often deal with multiple uses of water resources" (Bakker 2010a, 210).

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[39] About three percent of world's population is "supplied via private operators," but 20 percent of its urban population is (Bakker 2010a, 4).

Bakker recognizes (2010a, 211) that rural property regimes, including social ones, do remain "vitally important to water management; in querying property rights, the commons perspective invokes notions of justice as a social relation, invested with a moral dimension (rather than the modern view of justice as procedural)":

> On social grounds, the case for decentralization (or delegation, as it is sometimes termed) might seem compelling; but on environmental grounds, it is not. [. . .] This conclusion does not imply that communities should play no role in water governance. On the contrary, the tension between the need for centralized oversight and community control (the "corporate-community" tension) is inherent in our relationship with water.

The present study does not focus on the important question of ecological sustainability of various water proprietorship practices, but here I will briefly mention this matter in the context of critiques of neoliberalism. According to David Harvey (2005, 60), neoliberal economic systems tend to discourage sustainable management of natural resources, because their "preference for short-term contractual relations puts pressure on all producers to extract everything they can while the contract lasts." In the case of water, this generalization is probably only directly applicable to situations where water is "mined"; that is, extracted from an aquifer more quickly than it can be naturally or artificially recharged.

4.2.1 Water proprietorship

There is a vast literature on water issues in the developing world (e.g., Gleick 2006; Postel 2003; Singh 2008), sometimes alarmist, much of which focuses on the (so far) few places in the world where significant amounts of water are transferred between, or contested by, neighboring nations – occasionally mutually belligerent ones (see, e.g., Ehrenreich's 2011 article on "Israel's water war with Palestine," in which he describes a spring contested between two neighboring villages).

Proposals to reallocate water rights, or to create new systems to distribute them, often inspire angry reactions, especially when one of the parties has a commercial interest in the allotment. Karen Bakker (2010a, 4) posits that this is because:

> Water fulfills multiple functions and is imbued with many meanings. Water is simultaneously an economic output, an aesthetic reference, a religious symbol, a public service a private good, a cornerstone of public health, and a biophysical necessity for humans and ecosystems alike.
>
> Another reason for the fierceness of protests is the fact that water is, in some sense, a final frontier for capitalism. Essential for life and (at least in the case of drinking water) nonsubstitutible, water throws up challenging barriers—technical, ethical, and political–to private ownership and management. The water privatization debate is thus a microcosm of contemporary struggles over the roles of states and markets, and over the acceptability and efficacy of markets and private ownership as mechanisms for public services delivery and as solutions to the world's putative environmental crisis.

The present study focuses on springs because, in rural areas, these tend to be instilled with even more symbolic meaning than water in general. This is embodied by the English word "source," now a general term for any original thing, work, or idea from which something else derives, but once simply a synonym for "spring" – as it still is in French.

4.2.2 Water proprietorship and land issues in countries other than Mexico

I will briefly present here examples from three countries – a Canadian legal study, an academic investigation of a state in southern India, and body of political ecology research in Bolivia – to characterize the literature examining the intersection of water, land tenure, and the state in rural and indigenous places. I will conclude the subsection with a brief review of water law in the United States. A common thread is that the neoliberal focus on the "human right to water" will "provide additional leverage for states intent on wresting control of water resources from local communities" (Bakker 2010a, 149). However, these same studies also highlight the agency of indigenous peoples and other rural communities in adjusting the implementation of these policies (e.g., Knight 2010, 111).

In Canada, "water rights are an essential element of the settlement of land claims, and the establishment of comanagement regimes for natural resources" (Nowlan 2004, 5). "Co-management" is the legal term for rights vested in a group, although Canadian lawmakers are careful not to assume that all "aboriginal" or "First Nations" (i.e., indigenous) communities operate in the same way. Because most of Canada was effectively settled by Europeans from the British Isles, it is common law which laid the foundation for water rights practices, rather than the code-based legal systems which prevail in Mexico and, to a degree, in Quebec:

> Common law doctrine provided that flowing water could not be owned by an individual, except when the water was captured. [. . .] In 1895, a federal law was passed which declared that 'the property in and the right to the use' of all water was vested in the Crown [i.e., the state]. However, some First Nations believe that they have existing and superior rights to water.
>
> (Nowlan 2004, 12-13)

In the Indian state of Tamil Nadu, the history and present system of rural land tenure has interesting parallels to Mexico's. The village assembly, called *panchayat,* resembles a PROCEDE-surveyed *ejido* with a large, economically productive common use area as well as legally individualized parcels. Many of the *panchayat* duties involve water management:

> In Tamil Nadu, the village *panchayat* is a body corporate that has to maintain and manage the natural resources, particularly the common property resources. The village *panchayats* are vested with the responsibility of sinking and repairing wells; the excavation, repair, and maintenance of ponds or tanks [i.e., check dams]; maintenance and also utilization of unreserved forests and the like. It leases out the products from common sources such as fish, forest produce, water, and suchlike, to raise its revenue.
>
> (Annamali 2003, 250)

The *panchayat*'s role has gradually declined in favor of state forestry and water agencies. Some see this shift in responsibilities as a contributing factor to the accelerating depletion of natural resources, because it encourages personal disassociation from the resource, removing the incentive for timely revenue collection, resulting in poor management by both local residents and state bureaucracies (Annamali 2003, 252).

Bolivia has played a central role in popular and scholarly discussions of water rights, centered around two distinct but overlapping foci: Andean village-scale irrigation and land tenure practices, and the 2000 anti-neoliberal revolt in the eastern-Andean-foothills city of Cochabamba against corporate privatization of urban water provision. The first theme, of Andean rural water practices, is built upon academic cultural ecology research – e.g., geographer

Gregory Knapp's adaptive dynamics work in Ecuador (1991) – and includes efforts by geographer Karl Zimmerer (2009) and social scientist Rutgerd Boelens[40] (2009). The second theme, resistance to commercialized urban water services (e.g., Crespo Flores and Fernández 2001), became a cause-célèbre among NGOs and journalists.

In a book chapter which brings together land tenure, water sources, and hybrid indigeneity under neoliberal-influenced state programs, geographers Nina Laurie, Robert Andolina, and Sarah Radcliffe studied a collection of villages which applied for status as a *Tierra Comunitaria de Orígen* (TCO) equivalent to a Mexican *comunidad*. Most TCOs have been established not in the Andes, but in the eastern foothills and Amazonia, following the 1996 extension and clarification of Bolivia's 1952 land reform law. They (2002, 255) explain:

> In the highlands where existing land tenure is often contested, the state decided that new titling was needed in order to ensure that ownership was clarified so that land could be sold if so desired" and to "ensure that community land was not broken down into small plots. [. . .] Pressure from *campesino* and indigenous groups during the negotiations over the [national land reform] law meant that indigenous and original or ancestral communities (*comunidades originarias*) secured the possibility of asserting collective rights to legal land tenure.

Negotiations among World Bank, local NGOs, and community leaders focused on the "development of a network of small lagoons [within the TCOs] where each lagoon would provide approximately five families with water during times of scarcity" (Laurie, Andolina, and Radcliffe 2002, 258). However, the residents were reluctant to put water sources in the hands of the newly formalized village-scale entity, because even that would be too restrictive and exclusive; as one villager said in an assembly, "historically water doesn't belong to anyone," not even to a village group, but rather it belongs "to God." The compromise solution (Laurie, Andolina, and Radcliffe 2002, 261) was to pass *actas* relinquishing the village-scale collective rights to land and water in the vicinity of the lagoons:

> [This] example highlights a fundamental contradiction in the socially inclusive rhetoric of neoliberal land and water policies in Bolivia. The law indirectly opened up new opportunities for communal titles. [. . .] However, when land is discussed in

[40] Boelens directs the Water Law and Indigenous Rights (WALIR) research consortium, based in Wageningen University, the Netherlands, and affiliated with the United Nations.

> relation to the implementation of specific development projects the language of private ownership and commodification often prevails. [. . .] These discussions and the debate they generated point clearly to the types of problems that can arise with the introduction and implementation of new legislation that indirectly separates land and water issues.

Zimmerer (2000 and 2009) stresses the continuous evolution of multi-scale irrigation practices among Andean peoples in their creative engagements with Pre-Columbian (Inca), colonial, and modern state structures, and with the political ecologies of "neoliberalism and beyond."

Rocio Bustamante and Daniel Vega (2003) analyzed the relationships among Bolivia's legal land tenure forms and its local and regional water systems. They stressed that some indigenous concepts, e.g. the *ayllu,* have always proved troublesome for state-directed regimes, and that the neoliberal-tinged 1996 reform fails to recognize territories that are far from their controlling villages. The researchers found that each Andean community generally approaches the water-land nexus in one of two ways: either "water sources (lakes, reservoirs, springs, check dam ponds) are seen as belonging to the territory where they are found" – the "territory" being a village or a larger area with a unified irrigation system – or, the "water sources belong to the zone where they are used," even if this is far away. Multi-village systems (*mancomunados*) – often entire watersheds – were becoming more common than before, influenced by the gradual incorporation of the region into the standardized national set of county-level *municipios*. They found that the well-watered Bolivian Amazon region had less pressure on both land and water, but that the widespread practice of rotative and temporary agriculture necessitated the securing of "rights to this vast common terrain" (Bustamante and Vega 2003, 20).

The authors also examined communities which had been formed from former *haciendas*, in a way similar to how Mexican *ejidos* had formed, and found that the internal water distribution rules were defined more rigidly. In these villages, "water rights represent a certain durable individualization, a direct effect of the individual Agrarian Reform land grants that specifically include irrigation *turnos* [individual, strict water shares, rather than the older village-oriented system], and of later investments of labor and money to build or improve the hydraulic infrastructure" (Bustamante and Vega 2003, 19). A similar trend was observed by Boelens and

Gelles in Peru (2005, 322), where the traditional Quechua dual water circuit (*anasaya-urinsaya*, two sets of field for each village) was declining in favor of state-directed, but locally resident, water controllers.

The United States' water laws differ from Mexico's in several respects; most obviously, US laws vary more from state to state. Outright ownership of water by non-government actors (e.g., individual landowners) does exist in two states, Texas and Louisiana (Matthews 1984, 6). More important in terms of practical actions and litigation is the realm of water *rights*. Overall, the general trend has been one of gradual convergence with the state-managed concession permit system which dominates Mexico.

However, this generalization overlooks much variation, rooted in the different histories of the US states (long-settled, village-oriented Eastern states vs. more recently settled, individually-oriented Western states). For groundwater, most Eastern states use permits, while most Western ones use "appropriation" – i.e., "first come, first served." True to its partial Spanish colonial origins, California has a mixed system of appropriation, but "with some notion of sharing between overlying landowners" (Matthews 1984, 7). For surface water, the Southeastern states use permits, and the Mountain and Desert West regions use appropriation. Eastern states, and to a degree several others in the Pacific West and on the Great Plains, include another legal layer: "riparian" rights. These give the landowner permission to use surface water flowing through or past his property, but also place on the owner the responsibility to "leave unimpaired the quantity and quality of the water flowing by his land" (Matthews 1984, 45). Riparian rights stress the spatial proximity of a water source and a land parcel, while allocation demands that the owner continuously use the water (Matthews 1984, 46).

In Canada, Bolivia, India, and in the United States, a common trend has been the gradual standardization of legally sanctioned practices at the intersection of land ownership and water rights. The differences among these countries, and among their sub-national regions, often pertain to whether and how spatial proximity is a determining factor in these practices. Rural residents (as individuals or as village-scale entities), urban and industrial users, and the public or private entities which build the infrastructure linking these stakeholders each have different interests in the land-water nexus. The neoliberal project seeks to harmonize these interests in ways which can disrupt local practices.

4.2.3 Water law and practices in Mexico before the 1992 land tenure reforms

Four studies will serve to represent the body of scholarship on water management in the 19th and 20th centuries.[41] Two focus on the Porfiriato era (1876-1911): Raymond Craib's 2004 study of state-driven land tenure mapping work in Veracruz, and Patrick McNamara's 2007 examination of local and regional power dynamics in the Sierra Norte of Oaxaca. Two focus on the post-Revolution period: Philip Dennis' 1987 story of two villages in central Oaxaca, and Scott Whiteford and Francisco Bernal's 1996 study of Mexican water regimes before and after the 1992 land tenure reforms.

During the Porfiriato era, when state-initiated systematized land surveys prefigured much of the PROCEDE program, the control of waterways – national or local – was an important issue, as recounted by Craib (2004, 193-194) in an example from Veracruz state:

> As the Porfirian administration attempted to bring waterways under federal dominion, confusions arose as to which rivers were under federal jurisdiction and which remained under local control. More accurately, confusions arose as to which river had which name. Federal agencies may have emphatically determined, for example, that the Minas River fell under federal jurisdiction, but in an area striped with waterways, which river was the Minas River? At points of confluence, which waterway denoted the continuance of the Minas and which its tributary?

In his book *Sons of the Sierra,* McNamara asserts that contentious Porfiriato-era interactions between among indigenous villages, and between villages and the state (with parallels to the post-1992-reform era), did in fact often involve water, even in the relatively high-rainfall areas which coincide with the present study's focus regions. External parties with commercial intentions were a real factor, whereas in today's neoliberal-influenced period, these are still mainly a hypothetical concern – or potential boon, depending on one's position.

[41] For Pre-Columbian water governance in Mexico, see Rojas Rabiela 2009. For Colonial era water governance, see Sánchez 2002.

McNamara (2007, 129-130) demonstrates that the Porfirian state was not as inimical to village-oriented indigenous practices as many assume, nor were indigenous villagers as opposed to contractual remuneration for natural resources as many suppose:

> In addition to favorable treatment regarding tax increases, state officials granted Zapotec communities limited protection in preparing long-term contracts between native town councils and capitalist investors.
>
> [. . .] Issues surrounding water rights have received far less attention in the historical literature than have land disputes, though in many cases conflicts over water mattered as much or more than those over land. In fact, after the turn of the century, when foreign investors sought even greater opportunities in rural areas, water rights became the most important source of cash revenue for Indian municipalities.
>
> But because water was also so important for maintaining subsistence agricultural plots, leasing water rights to a mineral processing plant or a hydraulic-powered factory could undermine food supplies. [. . .] Consistent with the earlier era of consensus-based politics, Porfirian officials aggressively protected the interests of Zapotec communities in the face of unfair or potentially harmful water contracts.

McNamara (2007, 131) recounts the story of an American mining investor, George S. Clark, whose water rights contract with three Zapotec villages prompted a state bureaucrat to help the villagers demand better terms:

> The demand for greater access to water increased during the mining boom of 1895 to 1907, and many villages were being pressured to lease their rights to nearby rivers and streams. [. . .] If Zapotec villagers signed unfair contracts, unrest and dissatisfaction would surely build. In addition to relying on state bureaucrats, [. . .] Zapotec town councils often hired their own representatives to negotiate favorable contracts with foreign and Mexican businessmen.

Only after the mining boom declined did villagers begin to lose support of the state in their efforts to maintain fair water contracts. One large water-dependent commercial enterprise persisted: the Xia textile factory, whose lands now belong to the *núcleo* of Chicomezúchil.[42]

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[42] Chicomezúchil, one of my RAN document study nucleos, is where the first shots of the Sierra Norte component of the Mexican Revolution were fired: “In 1912 an armed rebellion against district officials would begin at the factory, and many of the Ixtepeji soldiers would seek their revenge” (McNamara 2007, 134).

Dennis' study of two villages in the Central Valley of Oaxaca during the 20th century includes two episodes related to water. In 1953, one of the villages, Zautla, built an underground canal from a reservoir whose catchment area is shared with another *núcleo*. Because it represented a village-scale investment in infrastructure, the second village, Mazaltepec, had to from then on pay the *comisariado* (village leader) to use the water (Dennis 1987, 86). The second eposide (Dennis 1987, 180) was specific to the villages' location on the outskirts of the growing state capital city of Oaxaca:

> In the Etla valley, an organization called the Committee for the Defense of Natural Resources was formed. The committee is composed of municipal presidents and *comisariados* serving as representatives of the various communities, and thus it carries some weight with higher government officials. The issue here is water rights. The tremendous growth of the city of Oaxaca and the perforation of deep wells have meant that less water is available than formerly in this rich and productive part of the valley. The committee's first action was to stop the well-drilling on village lands.

Whiteford and Bernal outline water law in rural Mexico through the course of the social property era. While their description applies more directly to low-rainfall areas, it does provide a succinct historical background (1996, 223) to the legal framework now in place nationwide:

> The confiscation and divisions of the haciendas…were often accompanied by the transfer of water rights from the hacienda to the *ejidos*. But some of the most contested struggles in agrarian history were for water rights. In some cases the rights did not accompany the land converted into *ejidos*. *Hacendados* were often able to sell their water rights to local peasant leaders before their lands were confiscated. Some of the most bitter intercommunity conflicts today can be traced to battles over water.

The overall impression of these and other accounts is that, while a simple history would divide Mexico into a proto-neoliberal Porfiriato period followed by a social-property-oriented post-Revolutionary period, the tone of negotiations among individuals, villages, and the state over water rights did not vary radically from one period to the next.

4.3 Village-scale orientation and the individual

Scholarship on villages overlaps with the vast and varied literature about communities in general, including the more specific themes of indigenous autonomy and common property resources. Key texts about village-scale territories and their natural resources include Ostrom, Gardner, and Walker's 1994 inquiry on the conditions of human cooperation, Sack's 1986 work on territory as a "means for reifying power" with clear rules of group membership, and Dunbar's 1998 assertion that 150 is the approximate maximum population within which stable social relationships can be maintained.

Perceived as a symbol of a pre-industrial past and a vanishing (or stubbornly persistent) remnant of that past, the village is both romanticized and demonized. Scholarly journalist Richard Critchfield (1981) praised the village as an institution which must be preserved in the developing world for practical agrarian reasons as well as cultural ones, while Christopher Hitchens (2007, 183) countered that "Gandhi rhapsodized about the Indian village, where the millennial rhythms of animals and crops would determine how human life was lived. Millions of people would have mindlessly starved to death if his advice had been followed." I will begin this section with reviews of several studies which stress the importance of village-scale practices, and follow this with a look at a few works which focus on the pervasive ways in which the village and the individual are inextricably bound.

4.3.1 Focus on the village

Scholarship which "favors" the village fits into two categories: first, empirical observations of how villages have dominated some region, during some time period, in some realms of power and practice; second, normative discourses which additionally claim that the village scale is superior for some stated reason, and so we must work to preserve it. Output of the second, normative type is allied with recent popular or semi-scholarly works which celebrate civic participation and face-to-face interactive communities in general, and bemoan their supposed replacement by the Internet, cell phones, and social networking[43] (e.g., Putnam 2000; Turkle 2011).

I focus here on the first, observational type, which includes works which define common property resources (e.g., Stevenson 1991) and studies which detail the specific contexts in which villages have dominated sociopolitical structures (e.g., Ouweneel and Miller 1990). McNamara (2007), echoing Wolf (1957), explained how Mexico in the last several centuries has been dominated by village-scale loci of power, but that this is not an *inherent* characteristic of its peoples. He writes (2007, 6-7):

> If Zapotec families endured Spanish colonialism in similar ways, this common history did not lead to a sense of regional solidarity. As in other parts of indigenous Mexico, colonial administrators exacerbated tensions between communities and encouraged a deeper sense of belonging to a single town rather than a broader ethnic affiliation. Catholic missionaries bolstered this sort of localism.

He continues (2007, 15):

> To be from one village as opposed to another, to be from one particular state, to be Mexican, these held meaning only in relationship to other villages, other states, other nations. During the Porfiriato, people from the Sierra Zapoteca maintained these oppositional identities as a result of their participation in defensing national sovereignty. A further transformation took place after 1920, when Zapotec armies signed a peace accord with the Constitutionalist government in Mexico City. In fact, Oaxaca's current relationship to the nation, its 'place' in Mexico's political, cultural, and economic life in the early twenty-first century, comes from this later transformation of regional and national space and not from some Pre-Columbian preservation of an imagined indigenous world that refused to change.

In the Chinantec indigenous region, within the area of the present study, José Manuel Escalante (1998, quoted in de Teresa 2000, 38) found that "the most complex communities are those where communitary consensus has broken down altogether and the struggle between

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[43] One might cite the influential Marxist scholar Rayomond Williams' book *The Country and the City* as an early example of this genre. While Williams did celebrate the village-scale community, in his assessment of the "enclosure movement" of state-driven commons elimination in 15th- to 19th-century Britian he was careful to stress that the land tenure trend was only a metaphenomenon of the corrosive effects of capitalism, and that individual autonomy was not always a bad thing (Williams 1973, 98-103).

factions dominates. In this type of locality the structures of power are formal, that is they obey written laws." Thus, the absence of written community statutes does not necessarily indicate a lack of unified village orientation, but may in fact signal the opposite.

Researchers debate whether the village dominance in Mexico is a tool of state control, or a reaction against the state, or some combination of both. Dennis (1987, 2) contends that "intervillage conflict has been one mechanism through which central governments have both exploited and maintained control over their peasant constituents," while Cohen (1999, 119) sees the decline of *tequio* (*ejido* or *comunidad* work obligatory for all members) in favor of *cooperaciones* (essentially, village taxes) as a positive response by villages to creatively supplant the state's otherwise increasing role in formal tax collection. Cohen (1999, 122) prefers to emphasize the "sense that native and peasant populations understand their position vis-à-vis the state […They] are not blind to the machinations of the state."

Specifically referring to water management, Boelens and Bustamante (2005) critique the half-way measures of state-driven neoliberalism as it has been employed in indigenous communities. They concede that the Mexican government (and the Chilean one before it) has made decentralization a priority, but insist that it has not embraced true participation of village-scale water user groups, except to co-opt existing local structures. Edith Kauffer Michel (2006, 229) paraphrased their findings thus:

> Boelens and Bustamante particularly question the policies of water management decentralization – much in vogue in Mexico's legal reforms – because they simply transfer the tasks but not the decision-making, and have had the effect of concentrating decisions and rights into the hands of the most powerful at the local or community scale.

Similarly, David Mosse (1997, 470) showed how the British colonial government in late 19^{th}-century India found it convenient to perpetuate, even "invent," a village-scale water management tradition for its own purposes. Just as Mexico's social property system, albeit modified, is as useful as ever to the state, the state's interest in community "customs and traditions" of resource management arose from an "awareness of financial implications arising from the state's obligation to maintain highly decentralized resources such as tanks [i.e., check dams] over which it had recently extended its proprietorial rights." That is, since water was owned by everyone in the country as a whole, but the state had limited economic resources to manage it, it needed to incorporate, co-opt, or invent local management practices:

> In the case of tank [i.e., check dam] irrigation in south India, the nineteenth century colonial government *required* the existence of autonomous traditions of tank maintenance for the administration of tens of thousands of irrigation tanks. When these traditions appeared to no longer exist they had to be re-invented, and where necessary (although futilely) upheld by the force of law.

The British *ryotwari* tenure system, much like the contemporaneous Porfiriato-era surveys in Mexico (and like PROCEDE a century later), “brought government into direct relation with the individual ‘tenants’ (*ryots*) who paid land tax based on detailed field-level settlement surveys” (Mosse 1997, 478). As in Mexico, the state’s interest in a village/individual hybridity continues even today: “An ideology of autonomous village systems rooted in the exigencies of colonial administration continues to divert attention away from persisting links within tank systems” (Mosse 1997, 479). Also parallel to Mexico’s experience, the village-scale *panchayat* predated the proto-neoliberal *ryotwari*, survived the late-19th-century period of *ryotwari* implementation and thrived during the mid-20th century. Perhaps presaging the future of the *ejido* and the *comunidad*, the power and extent of the *panchayat* diminished considerably in recent decades (Mathew 1994, 3).

Bakker (2007, 15) sees water as an especially appropriate theme with which to study how village-scale control interacts with other scales: “Essential for life, fresh water provides a powerful lens with which to examine these broader debates on the legitimate roles of governments, markets, and communities in environmental management and the provision of public services” Focusing on the provision of water services, especially to households, she proposes (2007, 28) placing the village along two theoretical axes, one representing the scale of control, and the other the sophistication of the infrastructure technology. The first axis ranges from “community control” (often, village-oriented) to “corporate control,” and the second axis from “artisanal” (more common to villages) to “industrial” Her main point is that a high degree of corporate (i.e., commercial) involvement in water provision does not always equate to highly engineered infrastructure, since the insufficiently-studied urban “water vendors” are both corporate and artisanal. Most village-scale supply systems, in contrast, are beholden to neither corporations, nor to the state (Bakker 2007, 39):

> A central theme running through much of this work is the autarkic (in the sense of self-sufficient) nature of community-managed water systems. This is particularly the case with rural or peri-urban water supply, where irrigation uses are of primary importance, and in which multiple uses of water (for drinking, bathing, and other household purposes) coexist. Local in nature, using small-scale (or 'appropriate') technology, community systems mobilize local labor and community participation, and although they are articulated with formal structures of government, they almost invariably vest governance at the community level.

Rutgerd Boelens (2009, 308), in his study of water management among Andean villages, stresses that this self-sufficiency is not maintained without effort: "Community struggles to defend water access are frequently framed as a defense of the legitimacy of community authority and community water rights as opposed to external actors (whether governmental or private)."

While these scholars do occasionally champion the persistence of some village-scale practices, their studies of village practices and governance in the modern world are sober accounts which avoid romantic essentializing. They present cases where certain village-scale actions have practical and symbolic value emerging from the villagers themselves, as well as ways in which this symbolism has been exploited by the state.

4.3.2 Focus on the interconnections between the village and the individual

Today's scholars (e.g., Appadurai 1996), steeped in critical theory and post-colonial approaches to structure and agency, tend to warn against romanticizing the village, preferring instead to analyze the interconnected, hybrid nature of village/individual relationships, and how both are linked to political systems and economy. This trend is related to efforts to recognize individual agency, including of "subaltern" individuals. To favor enforcement of universal human rights, even if they can run counter to certain indigenous (or other political and ethnic) practices which arguably strengthen the village-scale community, and to emphasize the fluid, contingent nature of human groupings (e.g., Sen 1999, 310). This dual emphasis is echoed in the work of the influential sociobiologist E. O. Wilson stated (quoted in Lehrer 2012, 42), who recently that he sees human nature

> [. . .] as hung in the balance between these two extremes. If our behavior was driven entirely by group selection, then we'd be robotic cooperators, like ants. But, if individual-level selection were the only thing that mattered, then we'd be entirely selfish. What makes us human is that our history has been shaped by both forces. We're stuck in between.

The most famous early observations of village/individual dynamics in the Americas were those of Alexis de Tocqueville, who in the early 19th century celebrated the blend of laissez-faire individualism and village-scale decision-making, which he observed throughout the young United States. De Tocqueville was especially impressed by the townships of New England, where town "selectmen" had to consult an assembly of all landowners before making important decisions. He found the township size – two to three thousand inhabitants, like my study village of Talea – to be "not so extensive that all its inhabitants do not have nearly the same interests and, on the other hand, it is sufficiently populated so that one is always sure of finding within it the elements of a good administration" (de Tocqueville 2000, 58). He opined that "the institutions of a township are to freedom what primary schools are to science; they put it within reach of the people; they make them taste its peaceful employ and habituate them to making use of it" (de Tocqueville 2000, 57), and that:

> It is in the township, at the center of the ordinary relations of life, that desire for esteem, the need of real interests, the taste for power and for attention, come to be concentrated; these passions, which so often trouble society, change character when they can be expressed so near the domestic hearth and in a way in the bosom of the family.

In a 2004 article, Chris Brown and Mark Purcell criticized cultural and political ecologists for too often paying lip service to multi-scale analyses, while in fact allowing their bias toward local (often, village-scale) practices and institutions to blind them to the inevitable, and sometimes even beneficial, interrelationships among all scales. They perceived this bias, for example, in the work of Erik Swyngedouw (1999), a "leading scale theorist and an insightful political ecologist working primarily on water provision." They blamed the local bias primarily on cultural ecology's earlier inspirations from biological ecology, when in fact even biologists had since expanded well beyond their own emphasis on "outdated notions of closed, stable ecological systems" (Brown and Purcell 2004, 611):

> Contemporary political ecologists often lament how the global economy dictates local cultural and ecological processes, assuming that more decision-making authority transferred to the local scale would allow the forces of culture and ecology to resist those of political economy. [. . .] This line of thinking misses the fundamental fact that political economy, culture, and ecology all exist and operate simultaneously at a range of scales.

Gavin Smith observed that academic social scientists are especially prone to this bias when they document resistance to apparent injustice: "When peasants rebel, we are often tempted to slip back into stereotypical and de-contextualized notions of the peasant *comunidad* as one of tradition and homogenous solidarity" (Smith 1999, 56), while Tristán Platt's work in the Bolivian Andes offered an early fusion of the individual and the village: "The function of a community is to collectively defend *individual* access to traditional economic resources, ensuring the reproduction of minimum conditions for agricultural production" (Platt 1982, 44).

In the central valley *núcleo* of Santa Ana, Oaxaca, Mexico, Jeffrey Cohen found that village-scale cooperation exists, but within limits (see also Parnell 1978). "Individuals complain when it comes time to pay the *guelaguetza* [community festival] debt. *Tequio* [] crews are typically hard to organize…*Cargos* and committees are often difficult to fill, and village leaders sometimes find it necessary to push [villagers] forcefully into *nombramientos* (positions of service in village committees)" (Cohen 1999, 2). Recognizing that cooperative relationships can be "exploitative structures that obscure the exercise of power" (Bordieu and Wacquant 1992), Cohen approached them as the "outcomes of individual social actions and choices, made within the confines of communities" (Cohen 1999, 7). However, the village still has strong symbolic meaning:

> The discussion of local history notes the connections between Santañeros and the state, the nation, and the world through time, to show that the cooperative and reciprocal relationships that typify the community are neither isolated inventions of a recently formed closed corporate system, the outcomes of a mythic and timeless pre-Hispanic past, nor a reflection of the shared psychological attitude of a population.

> Structures of cooperation have evolved within the village and its population through time. As the needs of villagers have changed, so have their cooperative relationships and the meaning of reciprocity and communal action.

Laura Nader's treatise (1990, 237-238) on local and regional legal practices among the Sierra Norte Zapotecs of Talea further illuminates the village-individual interplay:

> To understand the social meaning of property among the Talean Zapotec is to understand how they think about property in relation to the individual and how they relate to one another and their community. In a farming community land and water are central to survival, and other property such as poultry is central to networking. A position of power is crucial for access to agricultural resources, and the contest over power lies at the heart of disputes over scarce resources. [. . .] The relationships between these property rights of a subsistence nature and the social and cultural structure delineate a vision of the world that recognizes both individual and collective interests.

In his recent research in a cattle ranching region of northern Mexico, geographer Eric Perramond presents fascinating comparisons between social property residents and fully private property owners. He is careful to avoid equating "social" with "good" and "private" with "bad," while documenting that the distinction between "social" and "private" was never as clear-cut as many imagine it to be; for example, in most aspects, "*ejido* and community members [. . .] are more precisely smallholders, and few describe themselves as revolutionaries, much less as socialists." He points out (2010, 22):

> The caricature of ranchers with 'black hats' in Mexico is a familiar one to social scientists who have so often used private landowners as the bad guys, literally, in narrative strategies. [. . .] Simply put, the plurality of conflicts and concessions and the continuum of land-tenure diversity cannot be simplistically reduced to binaries of 'either/or' or 'communal versus private' owners.

He continues (2010, 10):

> Our conventional wisdom and scholarship thus poorly capture the processes and realities of landownership in Mexico. Few have written convincingly about *ejidatarios* becoming private landowners, much less private ranch owners, despite this being a common occurrence. Few have treated with any depth the practice of joint ownership (*condueñazgo*), or extended family owners, that begin to muddy the

> dichotomous waters of 'private' versus 'communal.' [. . .] Indeed, as I hope to make clear, land tenure is a continuum, not the binary function of private versus communal so apparently enforced in our popular and even academic conceptions of landownership in Mexico.

Perramond (2010, 34) found that large, modern ranches have some of the properties of pre-Revolutionary haciendas, but that analogies across time and space can be misleading:

> The complexity of land tenure in Mexico is legendary and has never held firm footing, even in historiography. Terms for land tenure or practices, adopted or modified from their Iberian or indigenous contexts, have changed in almost every century. Even regional comparisons are difficult in Mexico, where terms in Sonora rarely mean the same as they do in Yucatan.

Karen Bakker posits that the physical and practical qualities of water make it especially problematic for scale-dependent analyses: "Constraints imposed by biophysicality of resources such as water also complicate appeal to the local" (Bakker 2010a, 189). The "watershed" is often praised as a physical unit ideally scaled to water governance, most radically by "deep ecologists" who have proposed realigning the world's political jurisdictions to watersheds (e.g., Sale 1985) – and, significantly for Mexico's indigenous peoples, the watershed often approximates the scale of ethnic "territories" as the mere *núcleo* (village) cannot (see Oslender 2002, 94 and Offen 2003, 55 for the example of Pacific Colombia). Bakker (2010a, 189), however, thinks that the watershed is not necessarily the ideal scale, as it "does not correspond with biomes, or even groundwater distribution through aquifers" – it is too large for individual users such as farmers, yet too small to incorporate longer-distance water use impacts. She advises that we "embrace the resulting ambiguity" of diverse governances constructively:

> Proponents of community control are correct in arguing that conventional models of public and private sector management do not exhaust the range of alternatives…although they are incorrect when they argue that commons and communities are antitheses to the market or governments.

4.4 Indigenous perspectives on these concepts

Scholars of indigenous perspectives on land tenure, neoliberalism, villages and individuals, and water law must first grapple with the myriad definitions of "indigenous." While Soren Larsen and Jay Johnson (2012, 4) wrote that "the emergence of Indigenous geography was both accompanied and partly inspired by parallel developments in poststructuralism and cultural anthropology, allowing for fruitful cross-fertilization of ideas," others contend that "not only does the Anglophone word 'indigenous' fail to account for the myriad concepts of indigeneity, it also segments 'Indigenous research' into a discrete area of knowledge that is positioned in relation to Western scholarship" (Shaw, Herman, and Dobbs 2006, 3).

Post-neoliberal debates over the state's role in individual and collective control of land and natural resources interrelate with the "indigenous turn that has marked so much of Latin politics in recent years" (Lovell 2012, 173). The degree to which "indigenous" persons, communities, or territories should be treated as special legal categories is a matter of ongoing debate within states (countries) as well as within international organizations such as the United Nations, with "most states reluctant to accept legal obligations specifically based on this categorization" (Brownlie 1992, 60; see also Davis 1988). David Harvey warned that the increasing global focus on human rights, while well intentioned, can sometimes allow the individualizing tendencies of the neoliberal agenda to escape challenge (Harvey 2005, 62). Edith Kauffer Michel (2006, 231) advocates advocate greater recognition of simultaneous judicial structures. Extrapolating from her observations on water rights and social property, she wrote:

> Legal pluralism recognizes more than one legal order in the same socio-political space: that is, parallel to the state judicial order coexist one or more others; for example, at the community scale. The different legal structures (*ordenamientos*) interact with each other, sometimes complementing each other, or may enter into conflict. From the perspective of legal pluralism, there is not a hierarchy among the different regulatory systems (*ordenes jurídicos*), unlike the positivistic state vision of the law, which when it recognizes other systems, places them in a lower rank. [. . .] This is an encouraging element, but in many cases it fails to go beyond a formal recognition, without achieving inclusion in water laws, in the definition of water rights, and, even less, in the implementation of water management policies and in projects developed at the local scale. For this reason, we recommend adding to the

> analytical and judicial dimensions of legal pluralism, the socio-political perspective, without which the nascent promise (*planteamiento*) cannot be concretized.

Kauffer Michel (2006, 232) cited the example of Ghana, where the "coexistence of two judicial orders opens water management to the role of community authorities (Opoku-Agyemang 2005, 27-3). Nancy Peluso (2005) examined fluid and simultaneous land tenure regimes negotiated between local communities and the state in Indonesian Borneo. Denis Wood (2010, 238) discussed the 1920-1948 British cadastral survey of Mandate Palestine, where indigenous Ottoman Empire land tenure categories were replaced; e.g., the "*Musha'* lands, which villagers held in common and so resisted division and titling by individuals, were cast in an especially disreputable light since they were also held to mitigate against individual initiative and so against the rationalization of agricultural practice.

In Mexico, part of the discussion about individual and collective practices in indigenous communities stems from varying interpretations of Pre-Columbian evidence, whether archaeological, historical (from indigenous cultures with writing), or ethnographic (contact period). Here I can only touch on the large literature devoted to the subject. Much of the best scholarship is by authorities on cartography, e.g., Mundy (1996) and, for North American examples, Pearce (1998). The discussion is characterized by assertions such as that "in post-classic Mixtec city-states, local commoner groups owned farmland collectively" (Terraciano 2001, 205-206), while "the emphasis on territory and borders may have been a colonial period invention." In this vein, anthropologist Michael Smith (2009, 93) contends that the concept of territory was important for Pre-Columbian Mexican cultures, but conceived in a different way than the Spanish idea. Mexican cultures emphasized a particular city (e.g. Aztec *altepetl*), founded and headed by a particular dynasty, with poorly defined borders.

Some scholars (e.g., Scott 1998; Wainwright and Bryan 2009) contend that differences between indigenous peoples and 21st-century states regarding concepts of property and territory are always so deep that any indigenous engagement using state-defined legal tools must result in more harm than good. Others (e.g., Silvey 2010; Kelly et al. 2010) observe that interchanges between indigenous communities and the state are often nuanced, practical, and two-way. In their view, the state's practices toward property are one toolset among many, one which is not inherently harmful, although it can be harmful in particular situations. For example, anthropologist Paul Liffman (2011, 12) describes the Huichols of west-central Mexico as "by turns, exercis[ing] and represent[ing] their territoriality in terms of, independently of, and in opposition to the state's notions." He finds (2011, 80) that Huichols have long felt obligated to engage with the state's promotion of *núcleo*-scale identity and tenure, but they haven't allowed it take over their sense of a larger Huichol territory which they cognitively maintain through ritual practices, to a stronger degree than most other indigenous groups in Mexico.

4.4.1 Indigenous communities and the state

Some indigenous groups have responded to neoliberal-influenced state policies by organizing beyond their immediate communities (de la Peña 2006), for example in Guatemala (Fischer and McKenna Brown 1996). Partially counteracting this trend are the "progressive measures" within neoliberal policies, which have produced a "deepened state capacity to shape and neutralize political opposition" in Central America, resulting in a complex "neoliberal multiculturalism" (Hale 2005). In some cases, e.g. in the U.S. state of Alaska, indigenous peoples have found common cause with private landowners, and against state-driven conservation initiatives, in order to more fully exploit natural resources such as forests (Nelson 2004).

This mixed and sometimes contradictory interaction among indigenous communities and the state has been documented in the early 19th century Huasteca (Ducey 2004), among the Sierra Zapotecs during the Porfiriato era (McNamara 2007), and in the present time among the Huichols of western Mexico (Liffman 2011) and the valley Zapotecs (Cohen 1999). A theme running through these accounts is that these indigenous communities (defined broadly, not just as village-scale entities) do not simply react to the state, but rather that they actively assist in creating the state as it has evolved (Aguirre Beltrán 1991). This theme is especially pertinent in Mexico, where so much of the national identity is bound to a quasi-mythical concept of an inseparably fused "*mestizaje*" – a blending of indigenous and European which courses through every Mexican's veins. McNamara (2007, 21) observed that:

> Rather than a single community based on horizontal comradeship, Zapotecs during the Porfiriato imagined the nation as a confederation of multiple communities, each formed through vertical tensions around racial, class, gender, and generational identities [. . .] In effect, they had been willing to die [in the 1876 Tuxtepec Rebellion which brought Díaz to power with both Liberal and Conservative support] not because they imagined themselves as individuals within a 'horizontal comradeship' but because they imagined themselves as members of distinct communities allied in defense of local autonomy and national sovereignty. To borrow a phrase from the German historian Alon Confino, Zapotecs perceived the nation as a local metaphor.

While the *mestizo* foundation myth underpinning the Mexican state has produced a federal legal system which does not, in any practical sense, distinguish indigenous persons or territories from non-indigenous ones,[44] the recognition of indigenous community *rights* has recently begun to appear in the judicial code. This trend began in 1989 with a change to the state Constitution of Oaxaca to recognize "pluricultural" indigenous rights, which the national Constitution adopted in 1990. In 1994 (modified in 1998), Oaxaca again led the way by decreeing that "communities with similar ethnic composition could join together and incorporate" as new or modified *municipios*; again, the national code followed suit in 2001. A third pioneering change to Oaxaca's Constitution, in 1990, allowed the legal recognition of indigenous communities as legal entities (*personas jurídicas*, "legal persons" and thus potential parties to a lawsuit). This advance has not been adopted nationally; instead, the federal government in 2001 opted to recognize indigenous coalitions as mere "public interest entities." Furthermore, constitutional declarations mean little without state or local laws to apply them and money to enforce them (Sánchez Carreño 2008).

[44] One realm where Mexico's indigenous people have some distinction is in election laws. The concept *of usos y costumbres* allows *comunidades* (though not indigenous *ejidos*) to elect *núcleo*-level and *municipio*-level authorities according to their "traditional procedures." This legal provision is strongest in Oaxaca, where it was part of the 1990 state constitutional reform (EDUCA 2005).

However, in Mexico there is no legal category of indigenous territory akin to a US reservation, nor to post-neoliberal variants which exist in some countries (Tamburini 2007), nor is there a province-level administrative jurisdiction with codified indigenous authority, akin to the *comarcas* of Panama (Herlihy 1989). Instead, the indirectness of the legal links between indigeneity and land tenure in Mexico is comparable to that found in indigenous co-management of reserves created mainly for biodiversity conservation, e.g. in Honduras (Herlihy 2001) and in the southern Yucatán region of Mexico (Boege 2005).

A different Mexican law currently (as of May 2012) being considered by the federal legislative bodies, the *Ley de Consulta a los Pueblos y Comunidades Indígenas*, would create mechanisms by which indigenous individuals and communities (represented by village-scale bodies, or by larger coalitions) would have to be explicitly consulted for their advice on how to amend proposed federal laws (GPPAN 2012). While the law is intended to comply with the International Labor Organization's Convention 169, some have criticized it as a means by which the state can "concretize the capitalist appropriation of indigenous territories" by obtaining an indigenous imprimatur without changing the practical effects of actual laws (González García 2011, 10).

The association of indigenous "communities" with village-scale land tenure or jurisdictional units is an important aspect of political organization for indigenous peoples in various parts of the world.[45] Due to a combination of historical and geographical factors, Mexican rural societies, including indigenous ones, tend to be especially village-oriented, though some indigenous regions of Mexico are more village-oriented than others (van 't Hooft 2007, 18). This is explained succinctly by Roberto González (2001, 64), who, like many researchers who have worked in Oaxaca, implicitly equates "community" and "village":

> What seems unequivocal is that in northern Oaxaca the strongest ethnic allegiances are those related to community. Regional alliances among the Zapotec of the Northern Sierra are often tenuous, and intercommunity conflicts flare up from time to time. The difference between the situation in the Sierra and other parts of southern Mexico are made dramatically clear in varying notions of indigenous peoples' autonomy. In recent conferences and workshops, the Maya and Isthmus Zapotec expressed a preference for regional autonomous zones linking together many villages, while the Zapotec and the Mixe from the Northern Sierra argues that autonomy is likely only to work at the community level.

Matthew Restall (2006, 208) sees this village-scale identity in Mexico as being fundamentally pro-indigenous, because all "outsiders" can be treated with the same degree of disdain. "Even the phrase 'native defeat' is meaningless from a community perspective that

[45] Andrew Leake (2008, 114) described an interesting example of village-scale indigenous land rights actions among the Chaco peoples of Salta province, Argentina. Les Field (1996) recounted a comparable example among Otavalo communities in Ecuador.

views all outsiders more or less the same way, whether they be Spaniards, Mixtecs, Nahuas, or Zapotecs – or even people of the same language group who live in a separate town.” Others such as Alicia Barabas (2004, 107) contend that this strong village focus is a pernicious obstacle to regional-scale ethnically-based autonomy. If the Mexican village does decline significantly as an institution in coming decades, the effect on indigenous territoriality may be difficult to predict.

4.4.2 Indigenous rights and the natural resource of water

Most water-related cases of disagreement between indigenous communities and the state are fundamentally related to the more general question of “cultural pluralism” versus “universal human rights.” That is, “a potentially irreconcilable tension arises between the human right to water and traditional (communal) water rights – which are particularly important in places with indigenous populations” (Bakker 2010a, 12; see also Gálvez and Embriz Osorio 2008, 17). Natural resource rights are “often territorially based, local in nature,[46] and of crucial importance to indigenous peoples” (Bakker 2010a, 149; see also Godoy et al. 2005). The literature suggests that this tension can play out in three distinct situations. First, a large, water-related public works project can disrupt the livelihoods of a group of people who may be indigenous. Second, the public’s right to water can conflict with a de facto or de jure right of certain indigenous communities to own water outright. Third, a government’s efforts to standardize local water management regimes can be ignored or protested against by local communities, often indigenous ones.

In the first scenario, large public water infrastructure projects are initiated by the state, often benefitting private corporations as well as segments of the public. These can produce profound effects within a region (Bryant 1992, 15). As with any large public works, from airports to interstate highways, some communities suffer dislocation, loss of resources, or environmental problems. Although most countries have reasonably just procedures for

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[46] Similar debates surround the allocation of responsibilities for safeguarding the natural “resource” of biodiversity. Mexican biologists Jorge Soberón and José Sarukhan have stated that “almost every reference to biodiversity governance issues can, and should, be disaggregated to take into account the specificities of the different scales. […] The core of our argument is that shifting the scale almost always means changing the stakeholders” (Soberón and Sarukhan 2010, 2).

compensating those affected, evidence that indigenous peoples have suffered more than their fair share led in the 1990s to a groundswell of protests against the construction of massive dams (for hydropower, irrigation, or flood control). These protests persuaded the World Bank to scale back its indiscriminate offers of credit for such projects (Scudder 2005, 266).

At the edge of my Sierra Norte de Oaxaca study region there is a good example of such a project: the two reservoirs, built in 1974 and 1989, which together displaced 30,000 indigenous people (10,000 Chinantecs and 20,000 Mazatecs) in about 70 villages. The Temascal (Miguel Alemán) and Cerro de Oro (Miguel de la Madrid) reservoirs were part of the Papaloapan project, Mexico's answer to the Tennessee Valley Authority of the United States.[47] The Chinantec villagers whose land was flooded by the Cerro de Oro reservoir were given four options of places to move to, three of them small in area but easily irrigated, and the fourth – the Chimalapas region – a vast, rugged forest at one of Mexico's last internal colonization fronts. Political divisions led to different *núcleos* choosing to move to different locations, scattering what had previously been a spatially unified indigenous area (de Teresa 2000, 89-92). More recently, a conflict erupted between Mexico's Federal Electricity Commission and a group of *núcleos* in the state of Guerrero over the loss of land occasioned by the impending construction of the La Parota Reservoir, intended in part to augment the city of Acapulco's potable water system (Tovar 2009).

The second scenario, where public water services to advance the individual's right to water conflict with local water rights at the sources, tends to occur when a city depends on water originating in communities in its rural hinterland, but the rural communities object to the practical or symbolic interference with their local practices (Gentes 2003, 25). In section 1.2, I discussed the Mexican example of the village of Axocopa's provision of water to a nearby city. A more famous example occurred in 2000 in Bolivia's Cochabamba Valley. The same movement against the privatization of urban water provision also generated a disagreement (Bakker 2010a, 166) over the related issue of the state-corporate partnership seizing water rights from agricultural indigenous communities in the surrounding hills:

[47] A map of the project's accomplishments (Comisión del Río Papaloapan 1972) labels the states of Oaxaca, Veracruz, and Puebla beyond the watershed's perimeter, as if to suggest that the project area was, in a way, its own "state." Nevertheless, the visible impact on the already well-watered region as a whole was moderate. The map shows a large reservoir and a few smaller ones, resettlement zones, and five irrigation districts. Only one of the districts had significant infrastructure installed, for irrigating sugar cane (García Arenas 2007, 50).

> The contract gave the company exclusive rights to all of the water in the Cochabamba Valley, including rainwater, and private wells in rural areas surrounding the city. This was an unprecedented move, and unusual given that in the intensively farmed Andean mountain valley in which Cochabamba is located, wells and streams are essential sources of drinking water and irrigation for indigenous *campesinos*, who managed local water sources largely independent of external control. […] The company also undertook to place water meters on private wells and the local irrigation and cooperative water supply systems that rural and peri-urban residents had independently built and financed.

The protests, and the political trends which led to the election of Evo Morales in 2005, helped to forge a new national Water Law in 2004. The law gave villages much greater control over their internal water rights, approaching a degree of local water "ownership" greater than could possibly occur in Mexico without a radical change to its Constitution, where land can be locally owned (as social property *núcleos*) but water cannot. Karen Bakker, while sympathetic to indigenous practices, saw the 2004 Bolivian water law as a step too far in favor of village control, to the detriment of the greater public good (see also Paiement 2007, 14). She observed (2010a, 175-176) that village-scale water ownership shares some qualities with "privatization," though the owner is a defined, closed group of people rather than an individual:

> First, the formalization of these rights amounts to their privatization, insofar as private rights are allocated to individual rights holders (communities in this case). In other words, recognizing indigenous water rights, in this instance, implies removing water from the sphere of the 'commons' (belonging to all Bolivians) and allocating it to private (community) owners. I realize that my characterization of the creation of collective water rights as 'privatization' may seem objectionable to some. But it is technically correct: ownership passes from public (government) to private owners.
>
> Consider, moreover, the fact that risk of exclusion is high for those who do not belong to an eligible community (for example, peri-urban residents, or rural residents who are not identified as 'indigenous'). Second, the possibilities for the Bolivian state to plan or intervene in water resources management are potentially restricted. Third, water rights create the possibility of creation of water markets – in which water rights owners are to be reimbursed for allowing 'their' water to be diverted to others. In other words, the danger here is that a system of water rights akin to private-property rights is being created, but although these rights may provide some communities with an opportunity to engage in market exchange (e.g., via the sale of water rights, or the use thereof), they may not necessarily enable the poor within or beyond these communities to reap the benefits that markets can putative provide; nor do they create

> the context in which coherent, integrated management of water resources can effectively be conducted.

The third scenario, the bureaucratic intervention of the state in local water management practices, is not as radical or conflictive as the first two scenarios, but it is potentially more widespread, because it is not restricted to specific geographic situations such as large dams or periurban hinterlands (Stevenson 2006). It can affect countries like Mexico where the outright ownership of water, as opposed to allocation of rights, is not an issue because it does not legally exist. In a sense, such intervention is the opposite situation of the one in Bolivia, because it signifies deep and permanent state penetration into local practices, rather than the state removing itself from such powers.

In Mexico, this extension of the state has been realized through the standardization and expansion of the CONAGUA (federal water board) rights concession system, with parallels to the simultaneous land tenure standardization represented by the PROCEDE program. Kauffer Michel (2006, 220) described the effects on Tzotzil indigenous villages in the southern Mexico state of Chiapas. In the 1980s, Tzotzil villagers in several communities in the hills near the small city of San Cristóbal de las Casas began to develop a system using residual water (graywater and diluted, but untreated, wastewater) to irrigate their commercial flower gardens and nurseries. As is typical in well-watered communities, the irrigation system was not organized at the village level, but by individual families and sub-village groups. When CONAGUA became aware of the diversion of effluent occurring with neither a national-waters concession, nor a public health permit, they temporarily shut the village operations down, and a series of negotiations began between the state and the *núcleos*. According to Kauffer Michel (2006, 222), this episode "shows the incapacity of the National Water Law to incorporate existing management practices in indigenous communities, because these practices are carried out outside the law's normative, technocratic framework, and in perfect ignorance of the law's existence." She continued:

> In most cases, the indigenous farmers who carry out these irrigation activities are characterized by an ignorance of the legal regulation […] but when they find out about its existence, they do not express any worry because they consider the law as something alien and imposed, and unlikely to be enforced. Moreover, among the population, there is an opinion that the government intends to act upon natural resources with the goal of commercial exploitation. There exists an indigenous

> cosmovision in which the relationship with water does not obey a Western vision based on the hydrological cycle, but rather is related to cultural and spiritual aspects. In this sense, external intervention is doubly illegitimate.

4.4.3 Land and water in the environs of Talea, a Zapotec village

Anthropologists Laura Nader and Roberto González explored several of this study's themes as they applied to the village of Talea during the 50 years before I conducted fieldwork there.

Nader (1964, 212) reminds us that "each Zapotec village, no matter where in Oaxaca it is located, has its own 'personality'[…] Each village has had separate and distinct experiences with the Mexican government and with Mexican national culture in general." Today as well as in the past, Talea's local culture demonstrates a careful balance in several related ways: between individual orientation and village orientation, between welcoming outside people, ideas, and practices while still retaining some of the suspicious reserve stereotypical of Sierra Oaxacans, and between appearing superficially *mestizo* while self-identifying as deeply indigenous.

The internal individual orientation of Talea is expressed in part by its long-standing land tenure practices. Through the PROCEDE surveying and certification, these practices were recently sanctioned and registered by the state, while being only somewhat simplified. The following observations were made well before PROCEDE (in the case of Nader), and just as the PROCEDE officials were making their first contacts with the village (in the case of González). Nader (1990, 248) wrote:

> There are different types of ownership in Talea. An individual may be the single owner of a piece of property or a joint owner, as when two people share the ownership of a house. In addition, there is collective ownership, such as property purchased by a *barrio* or the village band collectively to ensure the continuity of their collectivity. Finally, there is communal ownership, whereby, for example, the village as an entity owns land that is legally recognized as communally held.

while González (2001, 41) observed:

> One of the clearest divisions Talean campesinos make is that between forests and cultivated areas. Nearly all of the forest above the village is communal land, where

> those who collect firewood may gather pine, oak, and other woods for burning in their homes. Cultivated areas are mostly held as private property, either with official land titles or as *bienes ocultos* (literally, 'occult' or 'hidden' lands, so called because no formal land title exists). *Bienes ocultos* were popular in the past as a way of evading government tax collectors, but among villagers they have been respected as private property.

This internal individual orientation toward cultivated land contrasts, for example, with the neighboring *núcleo* of Juquila, where in 1961 a "communal coffee nursery [. . .] was voted upon, and carried through, not without some reservations on the part of many, but it was a group decision, unanimously agreed upon" (Nader 1964, 214). The government agronomist who helped Juquila establish its nursery had a different experience in Talea:

> He had relatively quick success Talea [. . .] Only months later, when the nurseries had already been started, did public opinion develop strongly against the idea, and at that time the nurseries were taken over by a group particularly interested in coffee production**.** The nurseries were abandoned as a town project and now they are under private auspices.

This incident neatly demonstrates the relationship Talea typically has with state-directed initiatives: careful balance between working with the state and rejecting the state's recommendations. While "traditionally, Taleans try to obtain all they can in the form of government aid" (Nader 1964, 214), they also rework government initiatives to their own ends, or sometimes reject them altogether after the government has been shown to be untrustworthy or incompetent, as I was told in 2009 regarding a recent CONAFOR (federal forestry agency) forest regeneration project. In other words, "the Taleans work together to create and maintain an effective local identity against the state" (Nader 1990, 3), resisting state hegemony by, for example, administering more local law than many villages do. González (2001, 69) noted, however, that "as Taleans […] become increasingly sensitized to political issues, local rule appears to be increasingly threatened."

The cultural position of Talea at a midpoint between insular and worldly is manifested in several ways, including in its particular brand of indigeneity. González (2001, 32) found that:

> Contextualizing Talea poses a formidable task because the village, though relatively remote in some respects […] sits squarely in the world of international migration, mass communication, and global trade**.** The economic reliance of most Talean households on maize and beans has not impeded their participation in 'modernity.'

He continued (2001, 65):

> At first glance it is easy to pass Talea off as a *mestizo* or even Europeanized town. But an examination of the village's colonial history reveals that Taleans were subjected to the same mechanisms of colonial control, tribute extraction, and violence as other villages. In short, Talea was in every sense an 'Indian village.'
>
> It also has more of the superficial trappings of modernity – automobiles, televisions – than other Rincon villages. Nevertheless, the material conditions of most Taleans are remarkably similar to those of people living in other villages. They farm for a living on small parcels of land, generally live in one-, two-, or three-room adobe houses, and have a largely autonomous system of self-governance. They also continue to speak Zapotec.
>
> What is more, if asked, many Taleans describe their village as 'indigenous' (with an increasing sense of pride, especially among younger people). Rather than becoming embroiled in the long-running debate over what is 'Indian' and what is *mestizo*, it is perhaps more important to analyze how the categories themselves may be transformed.

4.5 Social property, neoliberalism, and water in today's Mexico

According to the Mexican Constitution, "land ownership [*propiedad*] does not imply ownership of the resource of water, whose right of exploitation depends on the granting of a concession," and that "communities which use their own collective irrigation systems are subject to the law, in the same way as formally recognized structures are, which implies the necessity of having a concession title." These legal facts, reiterated in the 2004 reform of the national Water Law, confirm that "neither an agrarian right nor a property title is a determinant for the ownership of, or access to, water" (Kauffer Michel 2006, 222). At the same time, the Water Law reform places a new emphasis on the individual's "right" to water (not to be confused with "ownership"), even if that individual is a member of a social property village (see section 7.5).

Given these facts, we can better understand how "communal" water management (in the sense of local, often village-scale practices) can sometimes more closely aligned with "privatization" of natural resources, than the public-oriented water policies of the state. As Kjell Enge and Scott Whiteford (1989, 10-11) encountered in their study of the Tehuacan Valley (Puebla and Oaxaca states) *galería* "communal" irrigation systems:

> Despite the state's expansion in the region in the 1970s and 1980s, particularly through efforts to control water distribution and management, local groups have historically resisted state control because water is privately owned in the valley. These associations were originally established during the 1940s and 1950s, when campesinos organized and constructed irrigation systems covering some seventeen thousand hectares without state initiative or financial support. In Tehuacan, irrigation associations […] continue to be based on voluntary membership and social control via peer pressure. Instead of seeking subsidized credit and state aid, campesinos have successfully resisted incorporation into state programs. The collectives maintain local control over water, which is also used to expand commercial production for local and national markets.

4.5.1 Land tenure in rural Mexico before PROCEDE

The "indirect rule" of limited village-scale autonomy in indigenous areas and some other rural regions was generally convenient for the colonial government, and for the national state which succeeded it (Carrera 2011, 178). The state could "extract labor and tribute, but not have to bother with daily administration," as well as for the villagers, who were "allowed retention of much of the traditional culture by giving the village a land base and a recognized form of social organization" (Dennis 1987, 29). During the late-19th-century Porfiriato era, the state's promotion of modern, pro-commerce, technocratic legal practices,[48] such as the 1890 Oaxaca state law which "ordered peasant communities to provide written title to the lands they farmed," actually sometimes reinforced this village orientation, by introducing cartographic delimitation and by explicitly forbidding common ownership by multi-village coalitions (McNamara 2007, 138).

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[48] The 19th-century technocratic systematization of state interventions in land tenure and water management was also occurring in countries such as Spain (Swyngedouw 2003b), Argentina (Gautreau and Garavaglia 2012), and Laos (Goldman 2004).

Inspired by the anti-Porfiriato philosophies of sociologist Andrés Molina Enríquez (1909), the political architects of the Revolution and its aftermath post-Revolution social property era established the state structures which, in fits and starts, transformed these villages into (or established new ones as) *ejidos* and *comunidades*. In some respects, the state's role was little changed. "In working to resolve land disputes through surveys, boundary-clearing procedures, and Presidential Resolutions, the [government] personnel are direct social descendants of the *corregidores* and *alcaldes mayores* of colonial times" (Dennis 1987, 28). Similarly, in certain regions the power structure of local elites remained intact, or was strengthened. "In northern Mexico, where the Revolution began, land tenure reform was a side note to regional and local battles between largely elite families, though it was big part of the rhetoric" (Perramond 2010, 51). At the opposite end of the country, in semi-feudal parts of Chiapas, *caciques* (local leaders, sometimes indigenous) found ways to co-opt the new laws to their advantage, leaving many landless (Nash 1994, 376; Watts 2004, 285). A contrasting example involving water is that of an Otomí indigenous *comunidad* in Hidalgo state where a spring was discovered in the 1940s. The resulting diversified, commercial crop system benefited the local *cacique*, but it also made villagers less subject to his control, while increasing local contact with government agencies (Mendoza Mendoza 2003, 69).

The social property system was patchy temporally as well as spatially. Each Mexican president embraced or ignored the advance of social property in his own way, and so "phases of populist land redistribution have been countered or subverted by private interests, or reversed, during parties that favored single-party ownership" (Perramond 2010, 51). For simplicity's sake I refer to the archival documents I read for this study as authored by the "RAN" (Registro Agrario Nacional), because they are stored in that institution today, but in fact many of them were originally written by, or addressed to, other institutions. The following list, adapted from Olmedo (1999) and Walker (2000), names the federal organization in charge of social property and rural land reform:

CNA (Comisión Nacional Agraria) – 1917-1934
DA (Departamento Agrario) – 1934-1958
DAAC (Departamento de Asuntos Agrarios y Colonización) – 1958-1974

SRA (Secretaría de la Reforma Agraria) – 1974-1995 (continues in limited capacity today)

Since 1928, the federal organization in charge of collecting related documents and, after 1995, making them publicly available has been called the RAN (Registro Agrario Nacional).

Each of these of these has or had an office in each of Mexico's state capitals. Additionally, each state has or had another organization, the CAM (Comisón Agraria Mixta). Each CAM is a board responsible for much of the groundwork of social property development, supervised this work from a more local level. Each board included one person appointed by the federal organization, one by the state, and one representing campesinos, the last drawn from a short list prepared by the State League of Agrarian Communities and Campesino Unions.

An important initiative during the social property era for indigenous communities occurred in 1940, when the RTBC program (*Reconocimiento y Titulación de Bienes Comunales,* or Recognition and Confirmation of Communal Assets) signaled an effort to pay as much attention to *comunidades* as had been paid to *ejidos*. In many cases, especially in periurban areas, the lands thus titled to indigenous villages had hitherto belonged to Catholic missions (Ledesma Barragán 2009).

In 1940, the Oaxacan historian Rosendo Pérez García provided a rare glimpse into de facto land tenure practices across an entire region, practices that left only traces in the official documents of government archives. He compiled a table (Pérez García 1996a, 274) listing the area in hectares of various de facto land tenure classes for 72 villages of the Sierra Norte. While some of the terminology has changed – his *lotes de propiedad particular* are de facto individual parcels, while his *predios mayores* are de facto common use areas – I was able to calculate several average figures. Villages fit into two distinct classes, large-area and small-area. The average common use area for large villages was 18,878 ha, for small ones 1,594 ha. In contrast, the parceled area averages were almost the same for both groups: 259 ha for large villages and 278 ha for small ones. Pérez García collected this data by talking with the authorities of each village.

Pérez García (1996a, 270-271) asserted that the Sierra Norte tradition of recognizing individual parcels within a village was initiated by the Catholic church during the colonial era, in conjunction with the policy of *congregación* (forced village clustering of formerly dispersed settlement):

> The only old [colonial-era] private properties [in the Sierra Norte] were those dedicated to cultivation for the promotion of religion. When the need to group inhabitants together was imposed, accomplished through congregating judges, to indoctrinate them and demand tribute, the best site for a village was chosen; first, the temple, Casa Real [government building], doctrinal schools, and future parade ground lots were set aside; then, lots were created for families of the ruling classes [*dirigentes*], [then] those connected to the temple, and the rest for the *macehuales* or common people.
>
> Thus, we believe, private property was born. The judges of Composición y Repartimiento were a decisive factor in creating personal property, because they awakened ambitions of those who could pay them a few pesos to deliver them the documents of some privileged parcel [*lote*].
>
> This conduct awakened animosity against these authorities and beneficiaries, and was one of the reasons some villages rebelled in 1660.

4.5.2 Land tenure in rural Mexico after PROCEDE

In my archival research at the Oaxaca RAN office, I came across a 2005 RTBC (official recognition of a *comunidad*) which revealed how some government officials continued to cite the social property ideals of the Revolutionary period, even well after the post-1992-reform era had commenced. The resolution (RAN 2005h, 461) resolved a dispute between two indigenous Chinantec *comunidades* by quoting the 1917 Ordinary Session of the Constituent Congress:

> The domain rights conceded to the Indians were at one time individual and similar to those of the Spanish, but generally they were given to communities and had the form of restricted private property. [The kings] respected the diverse forms of de facto possession which many Indians maintained. […] It is absolutely necessary that, from now on, our laws do not bypass the facts which are evident in reality.

This example shows how, on one hand, PROCEDE was “simplifying, standardizing, and homogenizing,” by imposing its state *techne* on the *metis* – the “local, embedded, context-sensitive community-based knowledge – which is inevitably heterogeneous and unruly, hence difficult for large organizations (whether public or private) to incorporate and adjucate in their drive to optimize resource production" (Bakker 2010a, 40). On the other hand, this same *regularización* could be portrayed to social property residents as a way to secure the tenure regimes they already practiced, both externally (via well-surveyed village borders) and internally (by legalizing the widespread, de facto individual parceling long in place).

The Mexican government cleverly modified its presentation of the PROCEDE program to communities, depending on whether the ethos of a region expressed a desire for individualized commercial opportunities, or a concern for maintaining village-scale autonomy (Leonard 2003). As geographer Eric Perramond (2010, 152) observed, "PROCEDE […] quickly became the focus of attention for both critics and proponents of this land counter-reform. […] In states where participation lagged early (or continues to), such as Chiapas and Oaxaca, the government used the rhetoric of judicial security, stating that titling would keep holders safe from any legal contests or questions regarding their land or resources."

For their part, *ejidos* and *comunidades* have always cleverly modified their proposals to the government, an aspect of what one might call "creative engagement." The following quote by anthropologist Nora Haenn (2006, 144) refers specifically to *ejidos* in the Calakmul forest frontier region of Mexico which only had their perimeters surveyed by PROCEDE, but the observation is, to some degree, more generally applicable:

> As long as people remain *ejidatarios*, they retain their constitutional claims on the state […] For 70-odd years, *ejidatarios* have used their position to gain state resources, build community with neighbors, and leverage their natural resource base in a variety of ways. At the same time, it seems clear from the combination of common and private property regimes favored by *ejido* members that *ejidatarios* are not necessarily committed to a single form of land tenure. Instead [they] strove to retain all the privileges of an *ejidatario* and all the privileges of a private property owner.

Another function of PROCEDE was to give social property villages an opportunity to add non-member residents to their membership rolls, which "can be seen as the final gasp of land distribution. Perhaps these *posesionarios* will be less likely to sell their parcels, because of lingering doubts about their legal rights as well as the fact that many have had to put more effort into acquiring these parcels" (Pérez Castañeda 1998, 72).

Researchers have noted that PROCEDE has – perhaps thankfully – failed to deliver on its promise of a truly standardized land tenure system. In part, this is due to the creative ways different villages have engaged with the program (Kelly et al. 2010; Barsimantov et al. 2010; Wilshusen 2010). Partly, however, it is simply due to the procedures stipulated by law not always being followed on the ground: "The whole process of *desamortazación* of lands is often done without the requirements of making the contract before witnesses, advising the *comisariado*, or submitting the title change with the RAN. This makes the *ejido* fall again toward irregularity" (Pérez Castañeda 1998, 77).

Whatever its practical goals, the PROCEDE program inserts the state more than ever in the practices of the rural communities, contrary to the professed goal of neoliberalism. In this, Perramond (2010, 123) recognized parallels with Porfiriato-era government land surveys:

> To decentralize its past duties as the national communal lands manager, the Mexican federal government had to re-embed itself in local communities and resurvey and remap the same places that were created as communal resources seventy years ago. The same process used to create the *ejido* after the Mexican Revolution is uncannily similar to the one now being followed to 'liberalize' the *ejido* sector and its ownership.

4.5.3 Natural resources and social property after PROCEDE

Soon after 1992, the impact of land tenure reform on the environment was identified as an important subject, a theme which community natural resources scholar David Barton Bray (1996, 215) considered to be inadequately researched:

> As the custodian of some 50 percent of the croplands and up to 80 percent of the forests of the country, the *ejido* sector clearly has vast implications for Mexico's rural environment […] What is not so obvious is what the nature of the impact [of changes in laws that regulate land access] might be and how much credit should be given to the reforms for any emergent changes in land use.
>
> In general, [Mexican geographer] Victor Toledo (1996) is quite correct when he notes that the environment is 'the great absence' in the debate around the reforms to Article 27. The reforms to the land tenure regime were not first and foremost an environmental measure, although some of the supporting legislation, notably the new forest and water laws, take on a more explicitly environmental tone.

I will discuss the 1992 Water Law in the next subsection. As for the land reform and its implementation through PROCEDE, it is interesting to note that its principal architect, Arturo Warman, thought that the overall environmental impact would be positive, since “the static *ejido* system has degraded the natural resource base” (Barton Bray 1996, 216). Toledo and others predicted that the environmental effects would be more negative than positive. A decade and a half later, one fruitful inquiry[49] would be to what extent PROCEDE surveying, certifying, and titling has provided new opportunities for village-scale, locally managed “protected areas.” As the late development studies scholar William Thiesenhusen (1995, 172) pointed out, it is difficult to generalize about land reform impacts on the environment in Mexico, because local land tenure practices vary widely, and because the biophysical environments themselves are so varied. For his part, Barton Bray (1996, 218) predicted that “the reform of Article 27, in and of itself, will not necessarily have a large impact on the environment of Mexico, but will be mediated by a variety of other political, social, and ecological factors” (Barton Bray).

As an example of the impact of land tenure reform on natural resource, geographer Matthew Fry (2011) detailed the decisions farmers in post-1992 Mexico must make if their land becomes potentially more valuable for non-renewable extraction of minerals and rock aggregate, especially if they are located near expanding cities. In his 2006 book *Política Hidroagrícola y Cambio Agrario en Tehuantepec, Oaxaca*, sociologist Yanga Villagómez identified links between land tenure and water in pre- and post-1992 Mexico (Villagómez, Santos Gómez, and Zafra 1998, 104), using examples from a drier region in Oaxaca state. In 1962, the federal government expropriated 47,000 hectares around a new reservoir for irrigation, and eventually apportioned part of the area to local landholders, leaving the rest as a new *ejido*. State interventions produced a weak village culture and strongly individualized reliance on government programs, partly due to the high cost and difficulty of maintaining the irrigation infrastructure.

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[49] In 1998 I initiated such a research project, collaborating with then-geographer Gerardo García Gil, in the Calakmul forest frontier region of Campeche state. *Ejidos* were established there between 1973 and 1992, and most had PROCEDE survey only their *núcleo* perimeters, keeping their individual parcels in a de facto state (Haenn 2006, 141). I plan to complete this study in the near future.

> The creation of Irrigation District 19 excluded an important fraction of campesinos from participating in the federal development strategy […] Moreover, the scheme of types of ownership stratified the campesinos, favoring the property titled landowners, mainly commercial crop producers, who were already the beneficiaries of regional agricultural development programs.

4.5.4 Mexican water law and policy since 1992

The 1992 Water Law that was somewhat modified in 2004 accomplished four major changes (Scott and Silva Ochoa 2001; Rap, Wester, and Pérez-Prado 2003; Wester, Hoogesteger, and Vincent 2009). First, it decentralized decisionmaking, mainly among rural irrigators. Second, it allowed water costs to rise – that is, the state reduced its subsidies of transport infrastructure costs, among both irrigators and urban potable water users. Third, it opened up water rights to be exchanged in markets. Fourth, it streamlined the already functioning state-controlled concession system. In this sub-section I will address criticisms of all four practices,[50] which collectively I refer to as "CONAGUA," the popular acronym for the federal water agency. I will conclude the chapter with a look at another recent government program related to water: the PESs (environmental services payments) administered by CONAFOR (the forestry agency), with CONAGUA involvement.

The decentralization component of the new Water Law primarily affects communities and individuals dependent on irrigation for growing crops. Until the 1990s, over half of the irrigated land in Mexico fell within large, federally-managed "Irrigation Districts," which included a mix of private, social, and national property, concentrated in the states of Sinaloa, Sonora, Tamaulipas, Michoacán, and Baja California. (Although my study area communities mainly receive enough rainfall to be unaffected by the CONAGUA decentralization, I discuss one such district in the Huasteca Potosina in chapter 7). The rest of the irrigated land consisted of "small systems privately managed or organized by user associations" (Whiteford and Bernal 1996, 224), many of them village-scale operations called "Irrigation Units." The effect of the new CONAGUA policies was to gradually dismantle the Irrigation Districts, apportioning the

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[50] A fifth element to the Water Law which has not yet been extensively employed "defines the conditions to decree regulated zones, of prohibition or reserve, whether due to risk of aquifer depletion, disasters, or to prevent irreversible ecosystem damage" (Gómez 2008, 6).

responsibilities among smaller "water use associations" or "modules" (*modulos*) (Ramos Valdes and Lorda Andrade 2004, 70). Meanwhile, regional (sub-national) water policy among government bodies at various scales is supposed to be harmonized through new "watershed councils" (Vargas 2003, 226).

In high-rainfall regions of Mexico, CONAGUA-organized village-scale or multi-village-scale water management associations are less common, and less highly organized, than they are in more irrigation-dependent regions. In water-poor areas, however, the shift to water use associations theoretically could strengthen the village orientation of social property *núcleos*, and even of village-sized collections of private property owners. Instead, in many cases the change has simply removed the state from its responsibilities to assist in infrastructure maintenance and administration, while allowing it to nonetheless retain much of its decision-making power, including its control over each system's headwaters. In the Mexicali Valley, this "top-down approach to decentralization aggravated many campesinos and heightened distrust," illustrating "some of the contradictions in the neoliberal policy and continued state control" (Whiteford and Bernal 1996, 225). In areas already with small-scale irrigation systems, "ranging from the elaborate futures markets in Tehuacan, Puebla[51][…] to private pumping networks in Sonora," the systematizing of the state's role can also represent an intrusion (Ostrom 1992), favoring urban water uses while encouraging individualized water management under a false banner of community organization (Vargas and Guzmán Ramírez 2008, 43). Scott Whiteford and Francisco Bernal (1996, 225-226) explained the complexities of these government interventions:

> [CONAGUA] gives the district concession of water and the permission for the utilization of the central canals. […] The *módulo* is a new unit of organization in Mexico, delineated by engineers of the CNA based on natural divisions of canals and fields. Once these divisions are made, they are imposed on the campesino population, often dividing communities, *ejidos* and *colonias*. At the same time, they merge segments of the population that traditionally have not worked together, the *pequeños propietarios* [private landowners] and the *ejidatarios*.

[51] In the Tehuacan Valley, just west of the Oaxaca study region, "water in the sugarcane fields is regulated by hours. Each parcel has a set amount of hours per month attached to it. Land values are attributed accordingly. Water is also divided up into canal groups that share the use of a spring. Each is controlled by an aguador. Canals are maintained by *ejido* (communal) resources but the entrances and gates are considered private and the responsibility of the owner" (Andrew Hilburn, University of Kansas PhD candidate, pers. comm., 2011).

> Each civil association is to be administered by an elected *Consejo Directivo* [council], which is under the control of a General Assembly of Users […] responsible for collection of water payments from the user, administering the system, and paying its water bills to the CNA. Tremendous political battles, intimidation, and violence have accompanied this realignment because the *consejo* ultimately controls the delivery, timing of delivery, and quantities of water campesinos receive.

The "transfer of authority to user groups is not seen as empowering but as a maneuver by the government to continue raising water prices" (Barton Bray 1996, 217). The new Water Law encourages replacement of government subsidies with user fees, to spread the costs of water transport infrastructure among agricultural irrigators and domestic potable water users. (CENCOS 2007). Spurred on by anti-water-pollution efforts led by environmental journalist Iván Restrepo (1995), and acknowledging the ubiquitous use of relatively expensive bottled drinking water among all but the rural poor,[52] the Mexican government couched these reforms as a fairer way for society to pay for cleaner urban water, while actually lowering rural irrigator water fees through greater efficiency (Whiteford and Bernal 1996, 229).

This predicted decline in water prices for rural irrigators has not occurred. In a groundwater-dependent agricultural area of Sonora state, Margaret Wilder and Scott Whiteford (2006, 347-350) found that *ejido* irrigators, who often share wells as sub-village groups, now have difficulty competing with private farmers with individual wells. They attributed this change partly on the government's decision to prioritize urban over rural water users through the reforms to the water laws, and partly on its preference for farmers whose commercial or export products take full advantage of post-NAFTA trade.

I reiterate that the Mexican Constitution, as clarified in the 1992 and 2004 Water Laws and the 1993 Norma Oficial Mexicana (regulatory policy), technically requires any water use other than manually extracted, natural-flow-conserving, domestically used water to be regulated by the state. This occurs through the issuing of a concession, either directly (e.g., to individual agricultural users), or indirectly (e.g., to the local authority responsible for a potable supply system) (Kauffer Michel 2006, 221). Unlike the other reforms, in theory this represents a

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[52] "A study released [in 2011] by the Inter-American Development Bank found that Mexicans used about 127 gallons of bottled water per person a year, more than four times the bottled-water consumption in the United States and more than any country surveyed" (Malkin 2012).

continuation of previous policies. For example, during my RAN archival research I encountered a 1969 document explaining how the Hydraulic Resources Ministry in Mexico City would grant "titles of legalization" to individuals, groups, or companies, including groups of *comuneros* and *ejidatarios*, granting them right to use specific amounts of national water from specific streams or rivers (SRH 1969b).

In practice, however, the post-1992 concession system is newly standardized and professionalized. This has provoked scattered instances of friction with local systems, especially in indigenous areas already skeptical of state intrusion (see sub-section 4.4.2 above). CONAGUA has limited manpower, and tends to strictly enforce concession laws strictly only in areas where public health is involved, especially near cities, or when a *núcleo* or individual asks the agency for technical or financial assistance with some water project.

This presents an interesting comparison with PROCEDE. PROCEDE certification is voluntary; it can legally be ignored or rebuffed by a community. A CONAGUA water rights concession is not supposed to be voluntary. However, the ways in which the two programs have been implemented has actually made PROCEDE more pervasive across space. PROCEDE made a strong attempt to work in every social property village, and so its presence is felt nearly everywhere, to one degree or another. In contrast, CONAGUA does not try to fully enforce its concession system in well-watered, relatively self-sufficient communities like those typical of the Huasteca Potosina and the Sierra Norte de Oaxaca. An exception is the potable water systems of large towns. In these places, CONAGUA has focused its permit and user fee enforcement efforts *especially* in well-watered areas like the Sierra Norte – not so much to raise money (the fees are always deeply discounted), but merely to remind local residents who is legally in charge of water, even if this exacerbates conflicts within and between communities (Flores Mondragon 2007, 46; Tiburcio Sánchez and Perevochtchikova 2012, 156).

As with any incompletely enforced law, the water concession system's limitations have fortified a defiance of the state among communities already inclined to this attitude. Kauffer Michel (2006, 224-225) documented the case of a Tzotzil village in Chiapas state:

> The interviewees expressed little confidence in the authorities, and an awareness of the frequent violation of the legal framework by the very same government agencies [. . .] This focus is sustained as something resembling engineering, and

> considers that the law is applicable over the entire Mexican territory, without any consideration for the existing cultural and ethnic diversity. [. . .] It is based on a supposed legal equality, but the day-to-day reality is characterized by strong socioeconomic inequalities.
>
> There is an undeclared government policy to not intervene in indigenous communities, to avoid arousing tensions. This only partly explains the absence of CNA action; really, the CNA has little ability and willingness to act and fulfill its role.

As with many aspects of rural and especially indigenous areas, in water policy the state is simultaneously perceived as doing too much and not doing enough (Whiteford and Bernal 1996, 232).

Another recently initiated expression of the state's interest in regulating landowner practices at certain water sources is "payment for environmental services" (PES). This takes the form of government programs which facilitate the modest transfer of cash from those who benefit from specific protection of biodiversity, forests, or water (e.g., companies whose products depend on clean water, or the taxpaying public), to individuals and communities who supposedly sacrifice some economically beneficial activity that would have harmed the resource (Prichard 2012). One link between some PES programs and the 1992 reforms to Mexican Water Law is through the new fee structures for some urban potable water systems, and for a few large irrigation systems. A percentage of these user fees can be assigned via PES to landowners in the source watershed.

While the direct or indirect economic and public health benefits are often justified with regard to water, the potentially harmful land use practices supposedly avoided more often have to do with conserving forests. Therefore, the rationalization for a typical PES program rests partly on scientific evidence which shows that forest cover does in fact help maintain the quality and/or quantity of water (see section 5.4). Relying on findings summarized in Playedra (2002), the Mexican government proposed a program called "PSA-H" [*Programa de Servicios Ambientales Hidrológicos,* Hydrological Environmental Services Program], which Alix-García and colleagues (2009, 165) describe thus:

> Although the relationship between forest cover and water flows is highly debated, there is clearly a positive effect of forests on water quality, if not always on quantity. For this reason, the original PES program proposal focused on the watersheds defined as overexploited, as well as on cloud forests,[53] which are thought to have a particularly strong relationship with water quantity.

PES programs are not a major focus of the present study, because they are not generally about protecting specific water sources with specific landowners, but rather about altering certain behaviors of many landowners over a large watershed. However, because PES is a part of the assemblage among natural resources, the state, and the village in the neoliberal-influenced era, here I will briefly review the Mexican PES system which began to be gradually rolled out in 2003. I draw primarily from two studies: one by Jennifer Alix-García, Alain de Janvry, Elisabeth Saloudet, and Jean Manuel Torres (2009), and the other by Kathleen McAfee and Elizabeth Shapiro (2010).

Unfortunately, the groundwater-recharging role of forests cannot address the most fundamental national-scale problem in Mexico, because "there is very little overlap of the forests with the overexploited aquifers" (Alix-García et al. 2009, 166). Thus, "the water-focus of the [PES program] in Mexico can only justify payments to very specific tracts of forest" (Alix-García et al. 2009, 167). After a two-year pilot program, two changes in policy were made: first, the degree of "marginalization" (in essence, poverty) of a community was removed from consideration; and second, the program was opened up to watersheds without over-exploitation of groundwater. These combined to make many more social property *núcleos* (some of them indigenous) eligible for enrollment. However, only a minority of *núcleos* fulfills the requirements that a town of at least 5,000 inhabitants be "nearby," and that its forest have at least "80 percent tree density," as observed in satellite imagery.

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[53] In the high Andes, *páramo* (alpine shrubby vegetation) is thought to act as a "sponge that stores rainwater and then releases it slowly over time" (Balaguer 2009, 29). Because this vegetation type can be found in indigenous areas above large cities, it has been a particular focus of PES programs in Colombia and Ecuador. In the latter country, "the indigenous perception that water in the *páramo* reserve [managed by five communities] is on the privatization chopping block runs so strong that they have opposed an agreement of cooperation" by which PES funds would be transferred from the water company supplying the city of Quito and from several water-dependent industries (Diehn 2005).

"For the first year of operation, *ejidos* and *comunidades* accounted for 47 percent of the contracts and for 93 percent of the area contracted" (Alix-García et al. 2009, 172). Nevertheless, the tree density requirement seems more geared to private, individual properties than to the de facto or de jure common use areas of social property *núcleos*, because it places a no-tree-cutting restriction on the entire "property" (i.e., the entire forested area of a *núcleo*), even if just a part of that forest is exploited for commercial timber or for scattered agriculture (Alix-García et al. 2009, 170). This policy disregards the complex land uses and de facto land tenures within social property village-scale territories.

In the first year of the pilot program, *ejidos* and *comunidades* varied in how they distributed the payments within their communities: "18 percent of *ejidos* distribute directly to members, 22 percent invest all of it in conservation-related forest activities, 18 percent allocate all of it to non-forestry public goods, and 42 percent do some combination" (Alix-García et al. 2009, 175). In a 2008 study of eleven PES *núcleos* in six states, the engagement of residents with the program was in many cases found to be sporadic. Most of the communities claimed to have intensified their conservation efforts thanks to the program, but "in some instances […] community members had trouble locating firebreaks and forest roads they claimed to be maintaining." Alix-García and colleagues (2009, 178) continued:

> One of the most discouraging findings was that in none of the communities visited were the objectives and rules of the program clear to the members […] Interestingly, the majority of the *ejidos* were able to identify the cities that benefited from the hydrological service provided by the conservation of their forests, but none of them realized that the payments they were receiving were meant to be in compensation for those services.

Urban water service providers (whether private or "municipal") which collected the payments from users were more engaged with the program than the private or social landowners which received them. An exception was the city of Coatapec, Veracruz, which suffered a drought and developed its own PES program, without federal intervention, by contracting with landowners (private and social) in the coffee-producing forested hills above the city (Alix-García et al. 2009, 184).

McAfee and Shapiro (2010, 3) also found that the government's PES program, much like PROCEDE, represents an attempt to standardize practices which vary widely across the human and physical geographies of rural Mexico:

> These 'environmental service providers' are likely to have their own formal or informal organizations, resource management practices, development priorities, and values with regard to nonhuman nature. These practices and values often cannot be reduced to the calculations of individual gain that, in neoliberal PES models, are expected to determine human behavior. In Mexico, these institutions and norms have combined to confound the model of market-based conservation efficiency envisioned by the World Bank and other economists who initially designed Mexico's PES programs. These conflicted interactions have transpired at the levels of the federal state, nationally and locally organized social movements, and *ejido* and indigenous polities.

These authors attest that the partial failure of this program is part of the same ethos which has condemned the impact of NAFTA on rural Mexican culture. Resistance to both policies stems from those who "insist that the values of ecosystems derive less from the market prices of their services than from their contributions to peasant livelihoods, food production, biodiversity, and wider social benefits that cannot be quantified or sold" (McAfee and Shapiro 2010, 2).

5. Results, part 1: Individual and village-scale orientation toward land and water in 33 *núcleos,* 1923-2007

My principal goal in examining the 1923-2007 Registro Agrario Nacional (RAN) legal documents was to identify and analyze the many ways that social property residents have chosen to emphasize either individual or village-scale practices related to land tenure, especially those practices which link land tenure to water source "ownership" and management. I had hypothesized that the state interventions since the 1992 land reforms would not, in most cases, reduce the level of overall village orientation. I processed about 400 anecdotes.[54] About 350 of these were drawn from approximately 200 document sets stored in the four state agrarian archives (two in each state); each set appears in the References section as an entry authored by "RAN." The remaining anecdotes were derived from interviews I conducted in several of the *núcleos*, from my own participatory mapping work in Talea, and from community and individual household questionnaires administered during the México Indígena project. Figures 2.1 through 2.6, on pages 47 to 59, show the locations of the 33 *núcleos* within the study regions.

In this context, an "anecdote" is an event, description, situation, or opinion recounted by someone – usually an individual villager, a *núcleo* authority, a government agent, a judge, or a neighboring landowner – which provides evidence of a personal, interpersonal, or institutional practice. Because the RAN is the state's locus of social property matters, nearly all these practices related to land, and some of these showed how land is related to natural resources such as forests or water.

I interpreted 293 of these 400 anecdotes as indicative of some manifestation of individual or village orientation. Many directly attested to this, while others required a more subjective reading; I considered these differences during my analysis. 71 related specifically to *water sources*, and 222 were concerned more generally with *land tenure* (including several concerning non-water natural resources such as forests). Most of my content analysis was qualitative, based on finding patterns and trends as shown in multiple anecdotes. I also attempted to explore the

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[54] In addition, I processed about 100 other RAN document sets which contained facts and announcements of official government actions, but not "anecdotes" as I use the term.

collection of anecdotes quantitatively (section 5.4). Given the limited sample size, especially of water-related documents, and the non-systematic criteria by which RAN saved certain documents for storage, as well as the partly subjective nature of my content analysis, this quantitative assessment must be interpreted with caution.

If the results had to be summarized in a single phrase, it would be that whatever general trends do exist are overshadowed by the inseparably entangled nature of individual and village orientation, both today and in the past. Nevertheless, two subtle trends are discernible amid the "noise" of *núcleo*-specific events and practices. The first trend is an increasing focus on the spatial location of water sources as either within individual parcels or within common use areas, regardless of whether these tenure areas have been surveyed and certified through PROCEDE (although PROCEDE parceling may accelerate the process).[55] Anecdote 1 (below) is a pre-1992 example of the de facto tenure's status as individual or common not mattering, compared to the urgency of keeping water access points within the *núcleo*'s territory.

> Anecdote 1. In Tancuime, letters from the *comunidad* to the DAAC (the federal organization in charge of social property and rural land reform) during the 1966 *Acta de Deslinde* (government survey of the *núcleo* perimeter) focus on access to streams as community right, in this case for cattle. However, the survey map eliminated all but one of the major stream access points which had appeared in the *núcleo*'s original map (*plano primordial*), in favor of two private landowners (RAN 1966a).

Illustrative anecdotes 2 and 3 demonstrate water source practices after 1992. Anecdote 2 is from a PROCEDE-parceled *núcleo*, while anecdote 3 is from a *núcleo* which did not have PROCEDE survey parcels of individuals. Both show the increasing or continued importance of water source locations within either "individual tenure" or "common use" areas. This development parallels the new legal emphasis in the Water Law (see section 7.5 and chapter 9).

[55] I reiterate that the trends discussed in this introduction are neither pervasive nor universal. Many of the anecdotes I present in later sections of this chapter run counter to them.

Anecdote 2. In Santa Cruz, each parcel owner has their own *presita* (small reservoir), for watering cattle and irrigating sugar cane. Thus, "they don't borrow water from each other" (interview with Lázaro Reyes 2009), as villagers do among, for example, Talea's coffee plantations.

Anecdote 3. In the 1970s, the *comunidad* of Cuatlamayán installed a tube from a *pozo* (shallow well, in this case at a natural pool) to a water storage tank 200 meters away, and another tube from the tank to the school about 1 km further north. Around 2006, the tube connecting the tank to the school burst. Efforts to fix the leak were thwarted, however, when the de facto owner of the parcel containing the *pozo* refused to allow its water to be used for community purposes, "not even if he were compensated" (interview with Hernández Reyes 2009).

This increasing linkage of water with land, if left unchecked, results in an overall increase in individual orientation toward water sources, because many important water sources are located within or very near agricultural parcels. However, there is a second trend discernible in some communities since 1992: *resistance* to this increasingly individual orientation. The resistance can take any of three forms. Anecdote 4 is an example of the first strategy: "accept the land tenure-water source linkage, but resist its individualizing tendency by adjusting the PROCEDE parceling template." The occurrence of this particular adjustment, "civic" parcels for community water purposes, may be in some regions as high as 40 percent of PROCEDE-parceled *núcleos* (see sub-section 7.4.1).

Anecdote 4. Huichimal's civic parcels include three for community water: one *pozo* and two *depósitos* (storage tanks). Of the 13 civic *solares* in its two human settlement areas, seven are water related: four *pozos* and three *depósitos* (RAN 2004b).

Anecdote 5 presents an example of the second strategy: "accept the PROCEDE parceling template, but avoid individual orientation toward water by resisting the land tenure-water source linkage." Talea (section 6.1) also exemplifies this strategy, through the common practice of individuals borrowing water from nearby parcels owned by others. This strategy probably depends on strong local culture and leadership for its continued success.

Anecdote 5. Santa Cruz, despite the overall individual orientation of its water practices, does exhibit several village-scale water arrangements. The main water source for the potable domestic supply, an improved "clear water" spring, is in a "private" (i.e., individual) cattle-ranching parcel (interview with López 2009).

Anecdote 6 is an example of the third strategy: "reject the PROCEDE parceling template, while also resisting the land tenure-water source linkage." Yagila (section 6.2) epitomizes this strategy as well, with its low concordance between users of water sources and their de facto landowners.

Anecdote 6. In Totomoxtla, 23 percent of the springs considered "important" by the community are located in the de facto "parceled" area, though this comprises only 5 percent of the total area. An additional 9 percent of important springs are in a small area of permanent agriculture that is locally considered to be "common use."

Anecdote 3 represented a so-far unsuccessful attempt to employ a fourth strategy: "reject the PROCEDE parceling template, while maintaining a strong land tenure-water source linkage, and apply community pressure to persuade individuals to nevertheless act in the community's interest." This strategy can be applied in PROCEDE-parceled *núcleos* as well. Tancuime (sub-section 3.1.2) offers a more successful example of this strategy, by which individual de facto parcel owners maintain forest patches around important springs.[56]

I begin this chapter with the history of interactions between social property *núcleos* and the Mexican state (section 5.1), before and after the 1992 land tenure reforms. I continue with a few examples of land tenure practices, before and after 1992 (section 5.2). This section ends with Figures 5.1.1 through 5.1.9 (on pages 195 to 203), maps showing the current spatial distribution of de jure land tenure classes in all 33 RAN document study *núcleos*. I then give examples of

[56] However, enforcing or encouraging specific land uses at certain locations is not as robust as assuming full village-scale control over such places.

practices related to water sources (section 5.3), concluding with a closer look at the post-1992 strategies I introduced above. Section 5.4 is a brief summary of key findings.

5.1 Interactions between núcleos *and the state, before and after 1992*

Many of the pre-PROCEDE RAN documents I examined represent official *actas* (legal decrees, although the term sometimes means "minutes of a meeting"), or communications and preparations leading up to those *actas*, on the part of the federal government of Mexico. These documents show how the creation of social property in Mexico was not a single act, but rather an ongoing process of negotiation, neglect, and engagement between the government and the residents of each *núcleo*, with each party expecting to gain greater legitimacy in the eyes of the other. While there are many variations, they can be grouped into three types: the *Resolución Presidencial* (Presidential Resolution); the *Reconocimiento y Titulación de Bienes Comunales* (Recognition and Titling of Communal Assets, or "RTBC"); and the *Acta de Deslinde* (Delimitation Decree). A Resolución Presidencial is typically the action which officially creates an *ejido* or *comunidad*; if for an *ejido*, it is often associated with a *dotación* (land grant on a former hacienda or national territory). An RTBC is a document which authenticates (or, in some cases, initiates) the existence of a *comunidad* (never an *ejido*). An Acta de Deslinde results from a physical survey which confirms or corrects the official territory belonging to a *núcleo* – usually an *ejido*, but sometimes a *comunidad*.

Among the 33 RAN document study communities, these legal actions took place throughout the 20th century, at times and in sequences which vary so much from one *núcleo* to the next as to almost defy any pattern. The pattern of state actions which does emerge runs counter to my expectations, in two ways. First, the period of greatest activity overall is probably toward the *end* of the era, in the 1980s.[57] Second, the periods of higher activity do *not* generally correspond to the widely recognized periods of intensified government initiative in the social property sector: the presidencies of Cárdenas and Ávila Camacho in the last 1930s and early 1940s, and the presidency of López Mateos from 1958 to 1964 (Meyer, Sherman, and Deeds

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[57] One RTBC document I encountered was signed by Arturo Warman, later an intellectual architect of the Salinas administration's neoliberal reforms (RAN 1977b).

2003, 579 and 626). Instead, for example, recognition and titling of *comunidades agrarias* through the RTBC mechanism seems to have peaked during the mid-1950s under Ruiz Cortines, and again in the late 1980s under de la Madrid.

The “village” as an idealized philosophical construct, enshrined in the legal system and in the national consciousness especially after the Mexican Revolution, has been embraced, exploited, or ignored by individuals, village leaders, and the state depending on particular circumstances of time, place, and motive. The political compromises which emerged from the Revolutionary period continue to be echoed in the complexities and ambiguities which pervade many of the practices attested in the RAN documents.

These ambiguities were apparent during the late 19th century, when the state’s use of the word “communal” “came (and has come) to obscure more than it revealed about actual land tenure and agrarian practice in the countryside” (Craib 2004, 95). Craib continues:

> Such complexities were elided by officials, as were the bundle of rights, rather than the notion of ownership, contained within the descriptor ‘communal’. As a result, the term ‘communal’ functioned not so much to describe an existing system but to describe what did not exist: individual freehold tenure and a system in which land circulated freely as a market commodity. It was, at best, a skewed representation of a complex and contextual reality that cannot simply be read through the retrospective lens of liberal theory.

A general observation is that engagement with state does not appear to correlate highly with especially high village orientation. *Núcleos* with a history of state engagement exhibited some kind of mixture of individual and village orientation, and continue to exhibit a mixture – albeit often modified – in their work with PROCEDE and afterwards. *Núcleos* with less of a state-interaction tradition were also mixed in their individual and village-oriented practices (although the mix was sometimes different than in other *núcleos*), and these *núcleos* also maintain hybrid practices in the twenty-first century.

5.1.1 How individuals, villages, and the state deployed the hybrid ideals of the Mexican Revolution

Many RAN anecdotes underscore how nearly all villages divided their territories into "parceled" and "common use" areas long before the PROCEDE program incorporated these tenure zones into the national cadastre. This is hardly a groundbreaking discovery on my part; most scholars I know of readily acknowledge this fact. Therefore, the pre-1992 "baseline" for village-scale orientation is not a purely communal entity,[58] but rather a balanced blend of village-scale and individual practices.

In the RAN documents, pre-1992 individual parcel documents were sometimes described in detail, for example, in Lachichina (RAN 1989-90; RAN 1991-92). On other occasions, parcel documents were merely mentioned as existing in a *núcleo*[59] – for example, in Yatzona (RAN 1981, 91) or in Huichimal (RAN 2004b, 66). Many government reports, typically generated as a first step toward a new survey-based decree, mentioned the existence of individually worked parcels that may have lacked individual formal documentation – e.g., in Lachixila (RAN 1973c). In Chimalaco, state-sanctioned individual parcel surveys were begun but never completed (RAN 1969).

A 1942 dispute within Lachichina over the boundary of individual *terreno* (de facto parcel in a named *paraje* or place) mentions several different legal documents confirming individual tenure. One of the litigating *comuneros* presented a disclosure (*manifestación*) signed by the county Rent Collection Authority, as well as documents by other *comuneros* which sanctioned (*ampara*) and confirmed (*reza*) that he owned the land up to a certain stream. The other then presented his own 1939 deed (*escritura*), signed by several authorities, which affirmed he was

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58 In chapter 8, I briefly discuss "collective" *ejidos*, where agricultural or natural resource extraction work is truly a group enterprise, usually for commercial purposes. Among the 33 RAN study *núcleos*, only Las Armas partially fits this description.

59 Laura Nader wrote of Talea (1990, 38) that "there is one common theme in regard to property: property (houses and land) is individually owned. A piece of property may be inerited jointly by a pair of siblings, but this joint ownership is usually temporary […] for joint ownership of property foreshadows conflict. The individual-ownership pattern […] does not imply that the use of property is individual. On the contrary, individual ownership is accompanied by joint use of property with the nuclear family."

the owner "up to the hill called Lomo Tabe." The two parties decided to divide the conflict area in half (RAN 1985). For Totomoxtla in 1945, at least fifteen "domain title transfers" had been recorded in the in Public Property Registry; each represented a "private sale deed" (*escritura*) with a "cadastral value" of 100 pesos (RAN 1945). The individual *comuneros* "had for decades been selling their lands and *solares* to people from Yolox and Quiotepec for laughable prices […] The Quiotepecans obliged them to work the lands as contractors" (Pérez García 1996b, 249). A teacher from another village helped them improve their harvests, until they were able to buy back 36 of the lost parcels (Pérez García 1996b, 331-3).

Guelatao, as the birthplace of the beloved 19th-century president Benito Jáurez, is a symbolic bastion of indigenous pride which pointedly rejected PROCEDE altogether. It is ironic, then, that (like Talea) its small territory was carved from neighboring *núcleos* well after they had been established, and that "it never had communal lands, as proven by the neighboring villages' documents; indeed, it couldn't even benefit from colonial-era laws, because of the mix of lots belonging to its own inhabitants and those of Ixtlán […] There exists ample individual documentation of sales, transfer, and willed inheritance of lands" (RAN 1992). In 1969, the Guelatao community participated in a precise survey of individually-"owned" parcels by the federal water ministry; the resulting map shows only a variable-width riparian strip as "forested," without a parcel number, implying that this was the sole non-urban "common use area" (SRH 1969a).

In La Alicia in 1961, RAN performed a precursor to PROCEDE's surveying of *grandes areas* – a formal (though unmapped) internal division into common use, parceled, and human settlement zones. According to the *Resolución Presidencial*, and confirmed by the *núcleo*'s own law (*Mandamiento del Ejecutivo Local*), 33 of the 57 *ejidatarios* were given 10-ha parcels in well-watered area, while the rest were given 20-ha parcels in the rotative-agriculture area. After subtracting the 20-ha urban zone, this left about 1,450 ha in de facto common use ("for use by the petitioning village"), which included both "hilly" and "cultivable" lands (RAN 1961).

In 1992, a *comunero* who had left the Tepetotutla to live in Oaxaca City asked the assembly to readmit him. However, upon leaving the community he had already sold his "house, *solar*, and part of his coffee parcels, as required by federal law" (RAN 1992). In Cuatlamayán in

1998, just before PROCEDE's first meeting with the *núcleo*, the assembly passed an *"acta de asignación de parcela,"* authorizing a man to divide his parcel among his sons. The document contained sketch maps and precise legal delimitations of boundaries[60] (*Comunidad* de Cuatlamayán 1998).

In the Oaxaca RAN office in 2009, I overheard a campesino complain that the rights to the parcel he had worked for 20 years were in his brother-in-law's name. The RAN administrator explained to him that, because it was social property, the RAN couldn't do anything – the transfer had to be resolved by the *núcleo*'s assembly. The most that the *Procuraduría Agraria* (government legal advocate for rural residents) could do is to help him convocate the assembly.

These examples show how the state often has expected villages to realize the social property ideals of Zapata and Cárdenas to an unrealistic degree. Other items show that the state nevertheless expects village authorities to execute any internal boundary paperwork with the same precision, formality, and thoroughness with which it carries out its own cadastral work. Even though – or perhaps because – Yagila did not have its individual parcels or *solares* surveyed by PROCEDE, Article 22 of its "boilerplate" community statute (see subsection 5.2.1, below) states that the *núcleo* authorities' responsibilities include "issuing documents (*constancias*) of possession of *solares* or parcels, and internal credentials of *comuneros*, to those who fulfill its statute and by authorization of the assembly." An entire section, section 2 (RAN 2001b), details practices concerning these de facto parcels (*tierras parceladas de hecho*) – although, my based on my fieldwork experiences, few of these requirements are fulfilled during a typical parcel assignment or change in ownership:

> Article 75 – The existence and assigning of de facto parcels in the community of San Juan Yagila is granted to those *comuneros* in possession, use, and enjoyment of their parcel, as is the ceding of rights to it in favor of their family members and *avecindados*, as stipulated in article 101 of the Agrarian Law, whichever his or her preference be.

[60] Similarly, in a *núcleo* in the Central Valley of Oaxaca, "within the village, of course, private lands are recognized and sold between community members. Private plots are legally recognized if a deed of sale is registered in Etla [the county seat] and the necessary taxes paid each year. In such a case the plots are registered as private lands within the communal holdings of the village. Because it requires paying taxes each year in Etla, few people declare private title to their bottomland" (Dennis 1987, 41). This appears to be an example of full privatization recognized by the *municipio* but not by the pre-PROCEDE federal government.

> Article 76 – Each *comunero* is obliged to delimit his parcels by drawing up (*levantando*) *Actas de Conformidad* with his neighbors, and should put up parcel boundary markers.
>
> Article 77 – Each *comunero* will accredit the right over a parcel with the Certificate of Agrarian Rights, or by the *Constancia de Posesión* issued by the *comisariado* with full authorization of the assembly; it should contain basic data about the *comunero* and about the parcel (measurements, neighboring properties, and name in Zapotec of the *paraje* (place) where it is located).

From time to time in all periods, the state has used the communal ideals of the Mexican Revolution to justify denying, or threatening to deny, social property status to a village it found to be too individual oriented, although the criteria for "too individual" varies among times and places.

An absence of individual parcels in a *núcleo* was occasionally noted in correspondence with the state. In 1937, the residents of Tazáquil claimed that they "have always worked their lands in communal form, without any of them being recognized as an individual owner of any parcel (*lote*), except for the *pequeños propietarios* noted on the map" (RAN 1937, 67). However, the *ejido* may not have been entirely truthful. The letter accompanied a request to the government for a 44-hectare extension of their territory, so it is not surprising that it speaks to the ideal of communal peasantry which suffused the Cárdenas administration.

Documents from nine *núcleos* attest to uncertainty, at one time or another, about whether a village should be considered a social property *núcleo* at all. The extent of this "status unresolved" category after the 1992 land tenure reforms is shown Figure 7.1 (page 300) and Figure 7.2 (page 305). In Yatzona, for example, a 1981 government inquiry found that the community was unsuitable for an RTBC because "it lacks property, possession, and dominion of the claimed lands; and furthermore, it does not maintain a communal state of exploitation of the lands, neither de facto nor de jure" (RAN 1981, 93). However, since the same government readily admits that only about 7 percent of *núcleos* engage in true "collective exploitation" (INEGI 2008), Yatzona must have been deemed to be exceptionally individual-oriented. This does seem to have been the case: the engineer who interviewed the *comunidad* authorities and 26 campesinos attested that "they stated they had no interest in following through on the RTBC dossier, since most of them use [*usufructan*] their land in the form of individual property, as they had written in an acta of November 16, 1980, signed by them and certified by the *presidente municipal*" (RAN 1981, 91). Because it was failed to achieve legal social property status, Yatzona has not become a candidate for PROCEDE surveying and certification. To the extent that PROCEDE work generally hastens the demise of village-scale practices, it is ironic that today Yatzona may be maintaining *more* of its residual village orientation than some of its PROCEDE-surveyed neighbors, precisely because it was found to be *not village-oriented enough* thirty years ago.

Talea requested an RTBC when it received its titles for communal lands in 1958 (RAN 1984b); the RTBC was not issued until 1984. The document was soon thereafter declared invalid, after government technicians discovered that Talea was "failing to work its land communally." The village did finally receive the equivalent of a permanent RTBC 1994, apparently because by then it had shown the government where its common use (forest) zone was located (RAN 1997d). In this case, in order to prove its worthiness as a social property *núcleo*, it had to expressly segregate its communally and individually worked areas.

In 1990, RAN investigated "*ejido* parcel usufruct" as it was practiced in La Alicia, to clarify the individual agrarian rights of those assigned to care for land meant to benefit the *ejido* directly. Two days later, the community deprived four *ejidatarios* of their rights, for having instead "*personally* cultivated their granted units for more than two years" (RAN 1990).

Even the PROCEDE program has sometimes been perceived as a state interference in village affairs which *hinders* the free transfer of parcels among individuals. In Talea during a PRM meeting, a *comunero* declared that "no one explained to us what PROCEDE implied. It's like the government became owners – they can take it away whenever they want to, though they're unlikely to do so. Now it's more complicated since PROCEDE, unlike in the urban zone [i.e., Villa Talea de Castro, not surveyed by PROCEDE], where you are the owner of your *solar*, and you just need to go to the notary public" (interview with Miranda 2009). This statement is surprising and fascinating, for two interrelated reasons. First, it shows that the government's expressed justification for neoliberal reform – to remove government regulation from individual actions – is sometimes seen as actually having the opposite effect (examples of this perception in Nicaragua are found in Broegaard 2009, 158). Second, it reveals a perception that the state is *more* of an “owner” of a *núcleo*’s land once PROCEDE has surveyed individual parcels than before. However, we should be cautious about making too much of this statement, for two reasons. First, Talea is a PROCEDE-parceled *comunidad* (not an *ejido*), and so it is in a sort of limbo state, with government-recognized individual parcels, yet without the freedom of legal individual parcel transactions to any buyer. Second, the *comunero*’s sentiment is only possible in a country with Mexico’s long history of informal transactions never recorded by the state.

State-*núcleo* interactions tend to demonstrate a mixture of individual and village-scale orientation. Only rarely does the blend take the form of an outright contradiction. Rather more often, the blend results from an ambiguity – a lack of clear and consistently applied policy or definition, perhaps sometimes to deliberately avoid having to resolve a politically expedient difference between de jure law and de facto practice. Most often, however, the blend is a “hybrid” – a practice or policy which is clearly and consistently applied in a certain place and time period, and in which the individual and village-oriented components are well understood and accepted by the parties involved, although not always practiced or enforced.

One of the questions PROCEDE functionaries asked prior to a *núcleo*’s survey was "Does community have parceled lands?” In one *comunidad*, the ambiguity inherent in the question was revealed by the answer being given as “yes,” but then changed to “no” after the next question ("What kind of economic parceling is there?") had been answered (RAN 2006b). A similar uncertainty was revealed in 1978, when a schoolteacher in a different *núcleo* requested that the government identify a piece of “communal land” and condemn these “*terrenos particulares*” (individual parcels) and donate them to the school. Nine years later, the *núcleo* did “symbolically” transfer the property to the federal education ministry (RAN 1977-80).

One example, from Tepetotula, raises the question: does a *núcleo* consist of its *people* (especially the *ejidatarios* and *comuneros*, with mainly inherited membership), or rather its *territory*, regardless of who owns and lives in it? In 1979, the government decided it had to perform the work for this *núcleo*’s Resolución Presidencial a second time (declaring the first attempt, from 1975, as invalid), because in the interim it had realized that the villagers who occupied the territory during the original 1934 land grant had subsequently left, to be replaced by the current group[61] (RAN 1980d). This hints at a strong link between people and their territory under Mexico's social property system, compared to, for example, any incorporated town or city in the United States, where the entire replacement of residents would not necessitate a new charter or new local laws. It also places a greater responsibility on the residents of a *núcleo* to continue to physically occupy their territory, lest they risk losing their rights as social property beneficiaries, as almost happened to the residents of Buenavista in the 1960s (RAN 1968-72).

Another case concerns a group of villagers who currently occupy the highland Chinantec *comunidad* of Totomoxtla, but who have deep historical ties to the humid lowland tropical/cloud forest territory of Chimalaco 25 km away (Pérez García 1996b, 328). The ambiguities which such cases present are problematic for any standardized cadastral system.

The case of Tampate offers a different kind of ambiguity more specific to the problems of a social property system. Tampate is composed of a heterogeneous collection of marginalized Huasteca hill farmers who had been granted a *dotación* of 4,063 "worthless" hectares in 1923, though they apparently never functioned as an *ejido*. By 1979, there were 1,906 inhabitants (440 heads of household), apparently some mix of non-farmers and day laborers or sharecroppers. Their request for a grant of fertile lowlands was denied in 1980, although two years later 82 "campesinos with secure rights" were allowed to move to lands in the Pujal-Coy Irrigation District (RAN 1979-82). On the INEGI 1:50,000-scale topographic map, and in air photographs, the dispersed settlement pattern of the lower, flatter eastern section of Tampate is evident, with scattered farms intermixed with forest and secondary vegetation through the linear ridges and incised valleys which cover most of the *núcleo*'s territory.

Other anecdotes illustrate how the state retained and reasserted its role in village policies whenever it issues one of the major *núcleo*-defining decrees. A 1940 *dotación* granted communal title to an *ejido*, but the *ejidatarios* were obligated to keep their roads in good shape, to "subject themselves to what the federal government dictates regarding *ejido* administration, and economic, agricultural, and social administration," and to "comply with regulations dictated by the Agriculture and Development Ministry regarding conservation, restoration, and propagation

[61] A related case is that of Huichimal. Here, the government was uncertain whether it had to initiate a new *Resolución Presidencial* after the original *núcleo* was divided into several separate *ejidos* (RAN 2003a).

of their forests and woodlands" (RAN 1940a, 5). A 1966 map showed that the federal parastatal PEMEX was digging an oil or gas well in another *núcleo*, but the absence of any mention of it in the accompanying documents implies that state owes community nothing when it exploits an entirely nationalized resource such as petroleum (RAN 1966b). When the state surveyed another *núcleo* in 1973 (to include urban zone exclave), they called the entire *ejido* "property of the nation" (DAAC 1973), a term usually reserved for lands outside of both private and social control.

At the same time, the government usually treated *ejidos* or *comunidades* as unitary stakeholders when other landowners asked to share their natural resource of water. In 1941, the Water Office of the government's Agrarian Department received applications from different private landowners for permission to use specified volumes of water from the El Bañito springs (for a swimming area) and the Río Choy (for irrigation). Because these waters passed through the *ejido* of Huichimal, its authorities were contacted by the government for their approval of the proposal (RAN 1941, 37-40). This was the only pre-1992 reference to a water rights concession I found in the RAN documents. The predecessors of CONAGUA certainly enforced concession laws and kept records of them,[62] but this seems to have only concerned the RAN when private landowners engaged with their social property neighbors.

5.1.2 Mechanics of the state's social property land tenure initiatives

Because it was the state's vehicle for gradually implementing the ideals of the Mexican Revolution, the RTBC surveying and certification of *comunidades* obviously emphasized the village as a territorial unit and legal landowner. To earn an RTBC or similar document, a *comunidad*'s residents were technically required to prove that they had "been possessing the lands in communal, peaceful, public character since time immemorial"; pre-existing titles from

[62] The Archivo Histórico del Agua (AHA) is an archive and library in Mexico City with approximately 100,000 dossiers (*expedientes*), reports, and other materials related to CONAGUA and its precursors, and to water in general in Mexico. Some of the materials are available online (http://archivohistoricodelagua.info/mx/), including its quarterly publication *Boletín del Archivo Histórico del Agua*. A worthwhile research project may be to build upon the present study by examining any materials in the AHA pertaining to the same 33 RAN document study nucleos, thereby approaching the land/water nexus from the "water" side rather than from the "land" side.

the colonial period or later were helpful, but not necessary. The final document typically described the perimeter boundary in segment lengths and compass directions (metes and bounds), with each point given a number or a boundary marker name (RAN 1977-81). The *comuneros* received "certificates of recognition of community membership," although in several cases some residents were excluded because they had been absent from community for over two years (RAN 1983).

The last *Resoluciones Presidenciales* were not executed until the PROCEDE program had already begun. While the cartographic products from these procedures were as modern in appearance as contemporaneous PROCEDE ones, the overall process was different than with PROCEDE. The surveying techniques were more old-fashioned (employing a "surveyor's line" rather than total station sites with precise GPS coordinates), few or none of the PROCEDE standard procedures or "boilerplate" documents were generated, and fewer options were offered for sub-*núcleo* land tenure classes (RAN 2002a).

The only recurring complaints I encountered regarding pre-PROCEDE surveying initiatives were about tardiness. Many of the archival documents convey an *ejido* or *comunidad*'s exasperation at the long delays between the government initiating or considering some work and its finishing the job. At least 10 of the 33 RAN document study *núcleos* had to wait over twenty years for Resolución Presidencial or RTBC work to be completed, for reasons which included the philosophical status uncertainties I discussed in the previous pages (which contributed to Buenavista's fifty year wait), weather delays, and simple incompetence and neglect. A typical example is Las Palmas, which petitioned the Cardenas government to appropriate the finca (large private estate) of La Amalia in 1938, but was officially granted *ejido* status in 1961 (RAN 1971a). Whatever its political or cultural consequences, the PROCEDE program's undisputed efficiency is all the more impressive when compared with its predecessors.

Some anecdotes recount how third party intermediaries would involve themselves in the affairs between *núcleos* and the government. The most frequent external presence was of various pro-*campesino* unions which offered assistance to, or at least solidarity with, *ejido* and *comunidad* authorities as they negotiated with the state.

The first example, from 1969, provides an ad hoc preview of PROCEDE. At the request of the Chimalaco *ejido* assembly, a government engineer was sent from Mexico City to do parcel surveys, but the *ejidatarios* complained that they didn't trust that particular engineer. The *Confederación Nacional Campesina* helped the *ejido* file the complaint, thus revealing that their loyalty was with *ejido* assembly decisions, even if this resulted in a rare state-sanctioned survey of individual parcels (RAN 1968, 205). In 1989, the same union strayed even further into government responsibilities, by commissioning topographers on behalf of the *ejido* of Huichimal to survey boundaries in a piece of land disputed with three other *núcleos*. Their survey was accepted a year later by the government as definitive (RAN 1989a).

Lachichina was officially considered private land while it awaited its *Resolución Presidencial*, which was finally decreed in 1980. When it became legally social, the de facto and de jure ambiguities and contradictions in its tenure system and history were used by village authorities as ammunition to wage a personal vendetta against a *comunero* who was accused of spending too much time away from the *comunidad*. A union, part of *Confederación Nacional Campesina*, helped the village authorities with their case as they sought to deprive a resident of his coffee farm (RAN 1989-90). A PROCEDE-era example demonstrates union encouragement of resistance to the government program. In Las Palmas, the leftist *Campesinos de America Unidos* supported the decision of a few *ejidatarios* to skip the meeting when PROCEDE individual parcel certificates were delivered (RAN 2005d).

Another intermediary in a few *núcleo*-government interactions was the primary school teacher, typically a formally educated, leftist-sympathizing urbanite with pretensions of organizing campesinos to better their conditions. In the several examples I encountered from various time periods, the teacher soon encounters opposition within the *núcleo* they are ostensibly trying to assist. One example is from Talea, where, according to one informant, "teachers from all over tried to take away land from the *comunidad*, for mining" (interview with Miranda 2009).

I examined documents from the entire period of the PROCEDE program (1993 to 2006), and from the first two years of the successor FANAR program (January 2007 through January 2009); in other words, from the first fifteen years of the implementation of neoliberal land tenure reform. Among the 33 study *núcleos*, the PROCEDE-FANAR program began in 1994 in Tazáquil, a small Nahuatl-speaking Huasteca *ejido* on the Panamerican Highway, and ended in 2007 in Tiltepec, a Zapotec-speaking *comunidad* in highland Oaxaca. Four of the 33 *núcleos* were surveyed and certified by PROCEDE very early in the program (1994-1995), all of these in the Huasteca. Eight *núcleos* were surveyed and certified very late in the study period (2005-2007), half of them in Oaxaca and half in the Huasteca.

The following anecdotes illustrate uncertainty about whether or not to participate in PROCEDE, including about the degree to which it promotes village-scale orientation. Some demonstrate assessments of PROCEDE by villagers several years after surveying had occurred. These anecdotes, unless cited otherwise, derive from the community questionnaires conducted during the México Indígena research project.

Documents reveal that in Yagila at first expressed a desire for parcel certificates, but later decided against the idea (RAN 2001d). In Cuatlamayán, true to its history of initiating semi-formal parcel surveys (reflective of its dispersed settlement pattern) while proudly retaining village-scale autonomy, also at first desired PROCEDE parcel certificates, but later opted instead to have only a few civic parcels surveyed (RAN 1997c). Much like Cuatlamayán, the *comunidad* of Zoochila (within the Oaxaca geodata analysis area but not one of the 33 RAN document study *núcleos*) has a “partly de jure, but self-generated, land tenure system – a ‘privatized’ indigenous community, yet without an internal PROCEDE survey” (interview with Cruz Piñeda 2008).

In the *comunidad* of Tancuime, PROCEDE was initially rebuffed, although not unanimously. In 1998, 140 voted in favor of PROCEDE doing some work, while 68 opposed, and 44 abstained. “During the assembly, diverse points concerning this program were presented, some considering it good to renew the community's and standardize the list of *comuneros*; others felt the PROCEDE program would not benefit them, and would not resolve any problems, and could create a situation where *comuneros* want to sell their parcels or *solares* to people from outside the community, and that this would create internal disorganization.” In the end, all 212 *comuneros* voted for PROCEDE to measure the perimeter boundary, but not to survey and certify individual parcels (RAN 1998m). In the *ejido* of La Pila, exactly half of the *ejidatarios* initially were in favor of PROCEDE work (RAN 1997b, 13), but the *núcleo* eventually chose to have its individual parcels surveyed. In Las Armas, there was some initial reluctance to do PROCEDE work, mainly for fear of having to pay new taxes[63] (RAN 1993a), but this *ejido* also did finally have parcels surveyed.

The PROCEDE program gave *ejidos* and *comunidades* an opportunity to update their membership lists to include newer residents who worked plots and collaborated in village life. Some *núcleos* embraced this opportunity more than others. La Pila admitted 119 new *ejidatarios*, but a document from the meeting in which PROCEDE delivered parcel certificates shows uncertainty about how many should share rights to common use area (RAN 1997b, 27). In Talea, authorities attested to me that even today there is “no community statute, but we need one, to clarify the rights and obligations of *comuneros* with parcels on the list [produced through PROCEDE]; their obligations aren't clear to them” (interview with Pascual García 2009). In Tancuime, the assembly of *comuneros* faced a dilemma: it wanted to add its large population of 526 residents without de facto agricultural plots to its membership list, but was told (erroneously, to my knowledge[64]) that this would have necessitated allowing PROCEDE to survey and title their individual *solares* in the human settlement areas. To avoid this perceived imposition of land privatization, “the general assembly proposed to continue granting this recognition only within the community” (RAN 2005a, 31).

The most common reason I was given for a *núcleo* deciding to participate in the PROCEDE program was to prevent or resolve boundary disputes with neighboring *núcleos*, sometimes expressed as “invasions”; this theme had also been common during the earlier state programs such as RTBC. Examples include Talea (Toro Yescas 2009) and Chimalaco. Less often, PROCEDE surveying of individual parcels was thought to prevent “fights among parcel [owners],” a notion attested in Las Armas. In this sense, PROCEDE participation can be considered a product of village orientation, and may in some cases enhance that orientation –

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[63] In their review of cadastral mapping as it developed in the service of European states, Roger Kain and Elizabeth Baigent (1992, 336) affirm that “the collecting of taxes and state revenues from land and resources drawn from that land, has been the overwhelming reason” for the growing practice.

[64] Lachixola, in the Oaxaca study region, had PROCEDE survey its individual parcels while avoiding surveying of its *solares*, thus keeping its main population center a “common use area.” Talea achieved much the same thing by excluding its main population center, though not its residents, from the *núcleo* altogether.

although, by (theoretically) quelling conflicts between one *núcleo* and another, it could also contribute to the elimination of one important source of village unity.

In a more individual-oriented vein, the *ejidos* of Chimalaco and Tazáquil, expressed satisfaction with PROCEDE parcel surveying because it provided them with the exact size of each parcel, and so taxes could be paid fairly by hectares, rather than equally by each community member. Tazáquil was also one of the few communities to mention a commonly stated neoliberal justification for individualized agricultural land tenure: that bank loans would be easier to obtain.

Residents of La Pila in 2007 expressed the opinion that “PROCEDE is beneficial because now we can sell parcels and *solares*, so there aren’t any more people demanding land, because now they have rights.” I am not certain what this was meant to convey, but it is possible that, by making a formal transfer of parcel rights more feasible than before, PROCEDE may actually raise the “barrier to entry” for outsiders to acquire land within the *ejido* boundaries. In other words, by requiring extra effort and paperwork, it is possible (though not at all certain) that some who normally would have acquired a parcel informally would decide that it isn’t worth the bother. This may actually reinforce the difference between insiders and outsiders, as Concheiro Borques and Diego Quintana (1998, 168) observed in varied regions on Mexico where “campesinos from the same village sell parcels to each other in order to maintain their communities.”

In Talea, a minority of *comuneros* was displeased with the eagerness of their *núcleo* authorities to authorize parcel surveying by PROCEDE. According to one older *comunero*, the *comisariado* during PROCEDE was “inexperienced and foolhardy” by allowing land-based actions to take place which only benefitted a few families, and some residents were considering a joint effort to undo these actions (interview with Miranda 2009).

5.1.3 Reactions to other post-1992 state programs related to land use

Besides property surveys and related actions, some RAN anecdotes and fieldwork interviews touched on other state programs and interests concerning natural resources in social property territories. One of the earliest documents I read is a surprisingly “eco-friendly” boilerplate local statute enacted in Chimalaco in the 1920s, which includes this passage (RAN 1928, 5-6):

> "Fifth: The residents [*vecinos*] of the Rancheria of Chimalaco are obligated, from this day onwards, to maintain, conserve, and promote the existing forest vegetation on the surface of the land conceded to them, and exploit it common, applying the product of said exploitation to the public services of the community, with the understanding that this cultivation of woodland be subject to the regulations [*ordenaciones*] relevant within the Forest Law [*Ley de Bosques*]."

During my fieldwork, some *núcleos* expressed satisfaction with various recent government initiatives. Totomoxtla "has no problems with government programs – a recent one is for deer hideouts – because they are often dealt with through NGOs, like the World Wildlife Fund" (interview with Pérez 2009). Yagila is "happy with the Payments for Environmental Services [PES] programs. The government has fulfilled its promises. CONAFOR [the federal forestry agency] helps pay us to bring pine saplings from nurseries in Tlacolula or Ixtlán" (interview with Ramos Francisco 2009).

Talea, on the other hand, was disappointed with the PES program. In 2008, CONAFOR tried to convince the *comunidad* authorities to participate, promising it would pay the community to build a nursery for pine trees, and that it would pay 5 pesos for each tree they planted. It turned out that the community had to buy the seedlings themselves (at 10 pesos each). The community, skeptical of the government's proposals, chose to do the reforestation tasks themselves, such as maintaining *aclareos* (small clearings to encourage faster growth of fewer trees), favoring natural seed banks over a capital and labor-intensive nursery, and emphasizing a certain variety of pine which they saw as a more secure investment than the one suggested by the government (Toro Yescas 2009; PRM workshop comments).

Talea's negative reaction to the PES proposal was exacerbated by the fact that one of the principal reasons for the program is to encourage the protection of water quality and abundance. While the state assumed Sierra residents would be grateful to receive tangible economic benefits, and official recognition, as guardians of the region's water, Taleans rightly understood that the true beneficiaries of the program would be private commercial interests, specifically a large brewery and Coca-Cola bottling plant in the downstream city of Tuxtepec. While enlightened economists might applaud the fact that these commercial interests were paying for part of the PES program, Taleans felt that this arrangement meant the government was "trying to take over [*adueñarse*] and sell its water to the big companies" (Toro Yescas 2009).

In Santa Cruz, another water-related assistance program serves as an example of the state bypassing the village altogether to assist individual farmers directly, despite the general attitude toward water as a community affair. There, the state of Oaxaca loaned machinery to certain *ejidatarios* so they could make irrigation ditches (interview with Lázaro Reyes 2009).

5.2 Land tenure practices before and after the 1992 reforms

In this section I explore land tenure practices in the RAN document study *núcleos*, for any insight they might provide into individual and village-scale orientation by themselves as well as for any contrast that might be discerned between them and the water-related practices I will consider in section 5.3. The principal finding is that land tenure practices tended to express a hybrid of individual and village-scale orientation before 1992, and that this hybrid orientation has persisted after the PROCEDE program was implemented. While the post-1992 anecdote data set is not large, it does appear that some *núcleos*, perhaps surprisingly, have shown signs of a slight increase in village orientation toward land tenure in this period.

5.2.1 Examples of village-scale and individual orientation

I begin with a pre-1992 example of hybrid orientation. Many of the *núcleos* indicated a scornful attitude toward individual selling of land or resources, but tended to reserve this scorn for occasions when it suited them for other reasons. In Lachixila, a poor Mixe man had arrived in 1968, and the *comunidad* allowed him to work a *paraje* (in this case, a parcel of communal land), as long has he fulfilled his duties as a village citizen. However, the man refused to let others work the *paraje*, even in 1983 killing his son-in-law when he tried to work on the parcel. In 1987, the community accused the man of "trafficking in communal lands." The accused replied that he was no longer the owner, but rather his children were, and that no one from Lachixila was working anywhere near the parcel. In 1989, the community denounced him further, for having taken away the "best irrigated lands" to raise cattle and plant maize (RAN 1987-89b).

I continue with several post-1992 anecdotes which indicate village-scale orientation. Two neighboring *comunidades*, Cuatlamayán and Cuajenco, chose to invert the PROCEDE paradigm by keeping their parcels in the legal common use area, while creating only a few individual parcels, all of them deeded to the community for civic purposes. It is surely not coincidental that both *comunidades* maintain a mainly dispersed settlement pattern; in Cuatlamayán, "only ten percent of residents live in the main population center" (interview with Hernández Reyes 2009). In such *núcleos*, the distinction between "urban house lot" and "agricultural parcel" is largely meaningless, although a few public features – school, water tower, cemetery, and community building – are clustered at a central location (RAN 1998e). It is possible that the residents of these *núcleos* understood that, because they were *comunidades* and not *ejidos*, any parcels they did create through PROCEDE would be protected from full privatization, at least under current law. Las Palmas did undergo standard PROCEDE parceling, but chose not to survey even the perimeter of its hilly 5,000-hectare territorial expansion (*ampliación*) (RAN 2005d). Thus, in the post-1992-reform era it remains with a large portion of its land in the same category as *núcleos* which did not participate in PROCEDE whatsoever.

In five of the nine Huasteca *ejidos* and *comunidades* who participated in México Indígena project – Chimalaco, Tazáquil, Las Armas, Santa Cruz, and La Pila – *tequio* was reported to be as active as it had been before the 1992 reforms; indeed, these were the same five *núcleos* which underwent PROCEDE parceling. Residents of El Chuchupe attested that "parcel sales are not allowed, even among *ejidatarios*," while even the meticulous meetings conducted in five *núcleos* to identify the characteristics of all parcels only found a few parcel sales in La Pila. In the Oaxaca *comunidad* of Teotlaxco, PROCEDE representatives found that "some work outside the *núcleo* for months, but are still considered *comuneros*, represented by family members" (RAN 2006b).

Other anecdotes highlight elements of individual orientation in communities. I begin with several from before the PROCEDE initiative.

The Mexican government since the Revolution has generally promoted itself as committed to the pro-community ideals which emerged, albeit in compromised fashion, during that period. Even during the current neoliberalized era, these ideals are often expressed as central to the national identity.[65] Nevertheless, I was surprised to encounter quite a few anecdotes, from before 1992 and after, in which the state wanted a *núcleo* to act more village-oriented than the *núcleo* itself preferred.

In 1968, Chimalaco *ejido* authorities asked the federal agrarian agency DAAC to conduct the "parceling of our *ejido*, or indicate to whom we should make this request, so it be done as quickly as possible. This parceling was approved by the assembly through a majority of votes, and recorded in the book of minutes" (RAN 1968, 201). The DAAC replied that they should petition the governor, or else another state agency they specified. The *ejido* replied by asking again for the "parceling of our *ejido*, since only by parceling will the many problems we have, and have not been able to resolve." The community had formed a committee of five to carefully study how to divide up the parcels for each *ejidatario* (RAN 1968, 205).

In Tampate in 1972, a *comunero* complained that others would not let him harvest his own coffee trees, and that this was because of the chaotic usufruct system, where "each campesino is working any parcel merely according to the possibilities each one has to cultivate them." He mistakenly believed that a *Resolución Presidencial*, which had not yet been issued, would include carefully surveyed individual parceling (RAN 1972b). In Chacatitla in 1977, a *comunero* sold 1 ha of his land to his son for 2,000 pesos, but the SRA (state ministry which includes the RAN) informed him that the transaction "had no validity," that "invariably a parcel cannot be divided but must remain registered in the name of the titular *comunero*," and the son should take the money back from the father, which father was willing to do (RAN 1977a). In 1981, a dispute over rights to a water source in Lachichina included one resident trying to charge the others 100,000 pesos. The others retorted that this was "unjust, seeing how this is no longer private property, according to our *Resolución Presidencial*" – implying that at least some residents assumed the *comunidad* was private property before the *Resolución* (RAN 1984-86).

[65] Since the Institutional Revolutionary Party regained the presidency of Mexico in 2012, it is likely that such rhetoric will only increase, at least temporarily. One plank in the party's platform asserts that "no form of property or social organization should be excluded" (PRI 2012).

In 1992, just as the Salinas administration was neoliberalizing the Mexican Constitution, the government nevertheless expressed concern about individuals profiting from natural resources. In Lachichina (not to be confused with Lachixila), one of the local authorities was cutting wood and selling it as an individual. The Agriculture and Hydrological Resources Ministry (SARH) sent a forest engineer to investigate this "illegal activity," but the engineer found that the wood was mainly just used within the community, to repair houses (RAN 1991-92).

PROCEDE-parceled *comunidades*, more than *ejidos*, are left with neither the degree of de facto freedom they enjoyed before to regulate land tenure, nor the de jure freedom envisioned by the architects of neoliberalism. In Talea, this has in a way forced the *núcleo* to act in a more village-oriented fashion than they had before, and more than they would prefer to act. For example, some complain that "before, a parcel owner could divide up his parcel and give a piece to each of his sons, just by getting a document signed by a judge; but now, he can't, he can only give it to one son" (interview with Toro Yescas 2009). In other words, by establishing more state regulatory involvement, PROCEDE can actually reintroduce some aspects of the original social property system, even if this is seen as a burden by some villagers. Another example is Las Armas, which asked for full title for their parcels, but according to the community questionnaire administered by the México Indígena team, for some reason the *ejido*'s request was rejected by the government.

Two Huasteca localities, La Subida (RAN 2003b) and Tampate, barely met the general criteria as social property *núcleos*, but achieved some village-scale political organization as the PROCEDE program was winding down. In the case of Tampate, the state government's indigenous affairs coordinator attempted to impose a *comunidad*-style system on what is, in legal terms, a failed attempt at an *ejido*. A 2011 newspaper article describes the incident as a conflict between rival factions within the village, and that violence was only narrowly averted (Castellanos 2011). Even in the post-1992-reform era, then, there are Mexican state bureaucrats whose sympathy for perceived indigenous community values clashes with the more individual-oriented preferences of at least some of the local stakeholders.[66]

The type of local law which most closely conforms to the state's idea of legal robustness is the *estatuto comunal* (*ejido* or *comunidad* statute). However, on the eve of the 1992 land tenure reforms, only 6 of the 13 *núcleos* which responded to this question claimed to have such a statute in force (RAN 1998g; RAN 1998m, 140; RAN 2001b; RAN 2005f). During the PROCEDE process, two of the *comunidades* with existing community statutes decided to update them (Yagila and Cacalotepec), while two others decided to enact them apparently for the first time – Santa Bárbara (RAN 1999i, 31) and Totomoxtla (RAN 2000c). This represents an example of PROCEDE *encouraging*, or at least a formalizing, greater village orientation. However, these four PROCEDE-era community statutes are clearly "boilerplate," state-initiated texts which hardly vary from one *núcleo* to the next and rarely deal with the unique problems and issues in any particular one.

I continue with a few post-1992 items that speak to the persistence or increase of some individually-oriented practices. Signs of increased individual orientation in some *ejidos* and *comunidades* include declines in the practice of *tequio* (in Cuatlamayán and La Pila), and the elimination of *tequio* activities connected to the land or natural resources (in El Chuchupe). Another sign of individualization is the decision to not establish any legal common use area during the PROCEDE surveying process, as happened in Lachixola (RAN 2002c), or to greatly reduce the de facto common use area as occurred in Chimalaco (diminishing its area from 70 ha to fewer than 6 ha).

The selling of parcels may have increased since the 1992 land tenure reforms (see sub-section 5.2.3, below), but only marginally, and the proportion of buyers from outside the communities has yet to make an appreciable impact in the study regions. However, even sales between community members were reported during México Indígena workshops to be problematic. In Cuatlamayán, these sales "generate conflicts among families." In Chimalaco, "sales have been made without consent of the assembly, nor of the authorities." In Tazáquil,

[66] Other cases of inter-agency conflicts of goals were noted by Zoomers and vander Haar (2000) in their review of bureaucratic procedures during recent land tenure reforms in Latin America.

"clandestine sales are being made [. . .] by handing over one's parcel title." Only the latter two of these three *núcleos* had PROCEDE parcel surveying done, but it does seem plausible that, by giving each individual a universally recognized document tied to a specific parcel of land, PROCEDE has made it easier for anyone to surrender control of their land, sometimes under dubious terms. Of course, easier transfer of individual parcels was the goal of the neoliberal project – but the continued practice of doing so under dubious terms was the very antithesis of its stated intentions.

5.2.2 PROCEDE's standardizing of tenure categories: Problems and adjustments

The most radical legal change introduced by PROCEDE is the formal surveying and certifying of individual parcels. A less obvious but in some cases no less important effect is the imposition of conceptually and spatially standardized tenure categories in villages which have more complex practices. In a sense, this development parallels the standardized water rights template simultaneously initiated through CONAGUA (sub-sections 4.4.2 and 4.5.4).

PROCEDE-surveyed common use areas are often, hilly areas covered in forest or grazing land. They are administered and utilized in some more purely village-oriented manner than other areas, but the actual practices vary. In other words, although the distinction between "parceled" and "common use" areas is now often more rigidly defined (both conceptually and spatially) than before, local variation, hybridity and ambiguity persist.

Naturally, this de jure/de facto divergence is most apparent in *núcleos* where the entire territory continues to be legally "common use."[67] In El Chuchupe, about 100 ha of the territory (about 7 percent of the total area) are cultivated, in individual fields by individual households. Some *ejidatarios* told the México Indígena team that these plots are individual, permanent "parcels" – some are demarcated by stones – while others made reference to "cultivated areas" worked only temporarily by any family. Air photographs confirm that the mosaic of forest, secondary vegetation, and farmland is complex. Because in this case there is almost no

[67] That is to say, "prior to the [PROCEDE] counter-reforms, many [nucleos] effectively combined private property (in the case of parcels) and common property (in the case of common lands). For these places, [PROCEDE] provided an additional foundation for mixed tenures" (Haenn 2006, 141).

permanent distinction between common use and parceled areas, the *ejido* claims that there are no special rules about what one is allowed to do in de facto common use areas.

Some *ejidos* and *comunidades* include areas between the zone of permanent parcels and the zone of (usually forested) common use. In these areas, which I call "intermediate," typically agriculture is allowed, but on temporary parcels, and with the permission of the *núcleo* authorities.[68] In Yagila, PROCEDE parceling was rejected, but the PROCEDE-inspired "boilerplate" communal statute was creatively adjusted by the *comunidad* to reflect the existence of intermediate areas: "Article 83: *Comuneros* may exploit common lands in the hot-land zone as long as they are not already being worked by other *comuneros*; they should advise the *comisariado*" (RAN 2001b). Because it is a rare example of a highly traditional *comunidad* with PROCEDE-surveyed parcels, Lachixola's de jure parcel map displays this intermediate area perfectly: a ring of small, permanent agricultural parcels around the main population center, with the rest of the territory divided into larger parcels.[69] (Figure 5.4, on page 216, shows the intermediate areas in the *comunidad* of Totomoxtla).

A relatively dispersed settlement pattern, where many or most permanent homes are in scattered agricultural parcels, was observed in at least three of the *núcleos* in the Huasteca (Chacatitla, Cuatlamayán, and Tancuime). None of them chose to have PROCEDE survey individual parcels, probably because the program treats *solares* so differently than parcels; for example, by granting *solares* full title immediately. In Chacatitla, "most live in cabins on the terrains they cultivate" (RAN 1964); this may partly explain why the *núcleo* wasn't granted an *Acta de Ejecucion y Deslinde* (similar to a *Resolución Presidencial*) until 1993, although it held a communal title from 1895. In 1984, Cuatlamayán decided to legally create an "urban zone," even though they continued to live mostly in dispersed settlement pattern. In their 1984 articles of incorporation, they explained that this was done for the "development of the community, since it will permit the easier introduction of potable water, electric energy, and other works of social benefit" (*Comunidad* de Cuatlamayán 1984). Likewise, in 1976 the *ejido* assembly of Chimalaco asked the RAN to "help them locate an urban area, to electrify our *ejido* and also to

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[68] "This type of land use, which combines a nucleus of permanently cultivated land with an outside area only sporadically cultivated, has been called an 'infield-outfield system' by [Eric] Wolf" (Dennis 1987, 40).

[69] In Fig. 5.1.6 on page 200, the two patterns are not discernible because individual parcels are not shown.

introduce drinking water" (RAN 1976b); in this case, the community did largely abandon its dispersed pattern, and later did undergo PROCEDE parceling, although a vestige of the old pattern is visible in a few clusters of unusually small, *solar*-sized parcels in parts of the *núcleo*.

A PROCEDE agent visiting the *comunidad* of Zoogochi found that "parceling does not exist, so we didn't bother doing the analysis of whose lands exceeds five percent [of the total parceled area]" (RAN 1998i). After having spent several days in Zoogochi for various projects (e.g., López Paniagua and Kelly 2002), I am certain that it has an area of permanently-assigned parcels around the human settlement area, as well as an "intermediate area" of more temporary parcels. Perhaps the PROCEDE agent was confused by the presence of the intermediate area.

The inability of the PROCEDE template to accommodate land tenure zones which shift over time is suggested by Yagila, which did not undergo PROCEDE parceling. In 2009, I observed a large area had been cleared of forest since my previous visit six months before. I was told that this represented "new requests by individuals to cut forest, in what was communal land, to plant *milpa* [maize] – it all just happens to be in the same area this year; they're not usually so concentrated. It also works the other way – sometimes people leave the land, and it reverts to being communal" (interview with Ramos Francisco 2009).

At the scale of cooperation among neighboring *ejidos* or *comunidades*, anecdotes were extremely rare, a fact which underscores the astonishing degree of village-scale self-identification which continues to typify rural Mexico. Indeed, both multi-*núcleo* anecdotes I encountered were from the same *núcleo*, Yagila. In 1967, the *comunidad* asked the government for an RTBC, but that it be done together with the neighboring *comunidad* of Josaa, an arrangement called "*mancomunado*" (RAN 1965-73). The state did not oblige this request. I am aware of one example of cooperation in the Sierra Norte of Oaxaca in which several villages are treated as a single *núcleo* even on official PROCEDE maps: the "*pueblos mancomunados*" of Amatlán, Yavesia, and Lachatao, which border Guelatao and Ixtlán.

In various ways, many *núcleos* creatively adjusted the PROCEDE template to more closely conform to local land tenure practices.

In Tancuime, PROCEDE was only asked to survey the *ejido* perimeter in 2005. Like in many other *núcleos*, the opportunity was taken to update the list of *ejidatarios*. The official list includes an unusual adjustment to local demands: a separate section for each of the five named sub-*núcleo* zones – four large areas of semi-dispersed settlement and agricultural parcels, plus the main population center (RAN 2005a, 7).

Parcel ownership by groups of village residents occurred in Las Armas, where all *ejido* members created a *sociedad* to commercially cultivate sugar cane in what PROCEDE called a "collective use area".[70] The other clear example of this is Talea, where PROCEDE documents affirm that "groups of people" own eleven parcels, one of them a 374-hectare terrain owned jointly by three women (RAN 2002e).

In Cacalotepec, the assembly made the unusual request to correct or add about 25 indigenous toponyms to their PROCEDE map, mainly at perimeter boundary markers. Some of these changes corrected the orthography of Zapotec place names, while others added secondary names in Zapotec or Spanish (RAN 2005c).

5.2.3 The effect of PROCEDE on parcel sales

After PROCEDE surveys individual parcels in an ejido or comunidad, an important locus of interaction among the individual, the village, and the state is the formal registering of any subsequent parcel transfers. In Table 5.1, I compare formal and informal transfer rates in five PROCEDE-parceled Huasteca núcleos. The formal transfer rates derive from 2006 RAN Agrarian Histories (RAN 2005h), while the informal transfer rates were obtained through México Indígena participatory fieldwork. The right columns "average annual parcel transfers: number of parcels, (as percentage of all parcels)" show that the typical non-death-related parcel transfer rate is significant but not strikingly high, less than half a percent of all parcels each year. Despite their varied geographies and histories, the rate is surprisingly consistent among the *núcleos*. The left column "percent of parcel transfers formalized" shows that, even after PROCEDE parceling, only about half of the transfers are legally registered. Unlike transfers

[70] "'Group parcels' belong to small groups of *ejidatarios* – small units of production, or infrastructure benefiting the *ejido* but not in the common use area. These made up only 1.7 percent of total area [of the nationwide sample of *núcleos*], mostly in northern states and in Yucatan" (Robles Berlanga 1998, 117).

overall, this figure does vary notably among the *núcleos*, from 30 percent in La Pila to 82 percent in Las Armas.

Table 5.1. Formal and informal transfers in ownership of individual parcels, in five PROCEDE-surveyed *núcleos* in the Huasteca. (*Includes both formal and informal transfers).

núcleo (years since PROCEDE, in 2006)	**% of parcel transfers formalized**	**average # of parcel transfers per year**			**average parcel transfers per year as % of all parcels in *núcleo***			
		formal	**in-formal**	**not death-related***	**formal**	**in-formal**	**all parcels**	**not death-related***
La Pila (9)	30	1.6	3.6	0.8	0.3	2.1	1.0	0.2
Santa Cruz (11)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1.7	n.d.
Las Armas (12)	82	1.5	0.3	0.8	1.0	0.2	1.2	0.5
Tazáquil (12)	48	1.6	1.8	0.5	1.1	1.2	2.3	0.3
Chimalaco (11)	36	2.6	4.7	1.5	0.6	1.2	1.8	0.4
AVERAGE	49	1.8	2.6	0.9	0.8	1.2	1.6	0.4

While results from only five *núcleos* cannot show overall patterns, they do suggest several tentative generalizations. First, PROCEDE-parceled *núcleos* are more likely to allow parcel sales (legal or illegal) to outsiders according to their community rules. Second, PROCEDE-parceled communities are more likely to allow parcel sales (of various kinds) without the need for assembly approval.[71] However, there are interesting variations. In communities where (legal or illegal) sales to outsiders are allowed, actual sales have sometimes not yet occurred, while in those where it is forbidden, even after PROCEDE parceling, it may actually be occurring. This exposes a second rift between de jure rules and de facto practices, at the level of the *núcleo* rather than of the state.

[71] We should not assume that working with PROCEDE *caused* these and other effects. PROCEDE communities may have been more individual-oriented before, influencing their decision to undergo PROCEDE parceling in the first place.

In sum, according to this small sample, more sales do occur in PROCEDE-parceled *núcleos* than in others, but not *overwhelmingly* more. More important, PROCEDE-parceled *ejidos* and *comunidades* tend to have more lenient rules at the community level, which opens the door to a much higher rate of sales than is currently occurring (legally or otherwise); and, sales in these *núcleos* are more likely to run counter to the community rules that do exist. In other words, while PROCEDE does allow for the (always rather common) de facto parcel selling to now be legalized, it can actually be ineffective, in two ways. First, only about half of sales are legalized, even after PROCEDE parceling. Second, it can be associated with (though not necessarily cause) greater than average mismatch between community rules and reality – despite the fact that community rules in PROCEDE-parceled *núcleos* are generally already more lenient than in other ones.

5.2.4 Land tenure maps of the RAN document study *núcleos* after neoliberal reforms

Figures 5.1.1 through 5.1.9 present a nine-page collage of all 33 RAN document study *núcleos* with continuous and undisputed social property status, plus Yatzona, which legally lost this status in 1981. These maps are intended to facilitate comparison of the spatial arrangement of their de jure land tenure types after the first 15 years of implementation of the 1992 reforms. These *núcleo* maps are grouped such that the collage progresses in order of degree of PROCEDE surveying and certification, starting with *núcleos* (whether *ejidos* or *comunidades*) which had no PROCEDE work at all, and ending with *ejidos* which had PROCEDE survey and certify individual parcels, leaving little or no common use area. Lighter patterns represent more village-oriented land tenure classes, while darker patterns indicate more individually-oriented ones. Whenever possible, a single scale is used for all *ejidos* and/or *comunidades* on a page, although space constraints prevented this in some cases.

Within each successive level of PROCEDE work, first Huasteca *núcleos* are shown, followed by Oaxaca ones. I reiterate that an *ejido* with individual PROCEDE parcels (e.g., La Pila) is more subject to complete land privatization than a *comunidad* with individual PROCEDE parcels (e.g., Talea). Therefore, individually-parceled *ejidos* are presented after the *comunidades*, and their parceled areas are shown in a darker color than parceled areas of *comunidades*.

For *núcleos* which had their interiors divided by PROCEDE into *grandes areas* (land tenure types), these are the zones displayed in the maps. The "special areas" (rights of way for relatively large watercourses and for certain kinds of public infrastructure such as highways) are also shown,[72] as these were also surveyed by PROCEDE though not legally included in any *gran area*.

For other *núcleos*, the entire polygon is shown as "common use area." If its perimeter was surveyed by PROCEDE, the common use area was legally declared in PROCEDE documents, and the *núcleo*'s perimeter is shown as a thick black line.[73] If no PROCEDE work was done at all, the entire *núcleo*'s status as a common use area is enshrined in a pre-PROCEDE *Resolución Presidencial*, RTBC, or other official document. The perimeters of these *núcleos* is shown as a light dashed line, to emphasize how few of these perimeters were ever surveyed with the technical precision and accuracy of PROCEDE.

Population centers, here defined as INEGI *localidades* with at least 200 inhabitants, are displayed for all *núcleos*. These are included for two reasons: to distinguish single-village and multi-village *núcleos,* and to show where de jure human settlement areas might be located if the non-PROCEDE ones were to undergo this work through FANAR. Several Oaxaca *núcleos* (e.g., Totomoxtla) had PROCEDE survey the perimeter of their human settlement area, without surveying or titling individual *solares* (house lots). Legally, this action is of little or no consequence; these "human settlement areas without *solares*" are as much a de jure "common use area" as the rest of their *núcleo* territories.

Besides the three principal PROCEDE-defined land tenure types (common use area, area of individual parcels, and human settlement area), an additional, more specific land tenure type is shown for those *núcleos* where it exists: the civic parcel. I repeat that a civic parcel is legally a parcel like any other within an "area of individual parcels," but which happens to be owned (certified to) the *ejido* or *comunidad* as a whole. A parcel can be owned by the *núcleo* for any of several reasons, including some reasons which have nothing to do with intentional civic purpose.

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[72] Only in Lachixola was a "special area" designated specifically as a "spring."

[73] Nora Haenn (2006, 145) predicts that residents of perimeter-only PROCEDE-surveyed nucleos "will continue to live within communities which are de jure common property and de facto a mix between private and common property."

In many cases, a civic purpose is intended – and sometimes, that purpose is the protection of a common water source.

Note that there are two kinds of civic parcels. The first kind are in a *núcleo* (the examples here are Cuatlamayán and Cuajenco) where these are the only individual parcels. In other words, the community chose to invert the standard PROCEDE template, by making their de facto public lands legal parcels, while leaving their de facto individual parcels as legal "common use areas." The second, more common kind of civic parcels are in a *núcleo* (e.g., Talea) which did follow the standard PROCEDE template, and so its civic parcels comprise just a handful of the many parcels, the vast majority of which are owned by individual heads of households.

Figure 5.1.1. RAN document study *núcleos*, map 1 (of 9): De jure land tenure areas in 2009. (Sources: RAN archival documents, including PROCEDE maps; INEGI 2011).

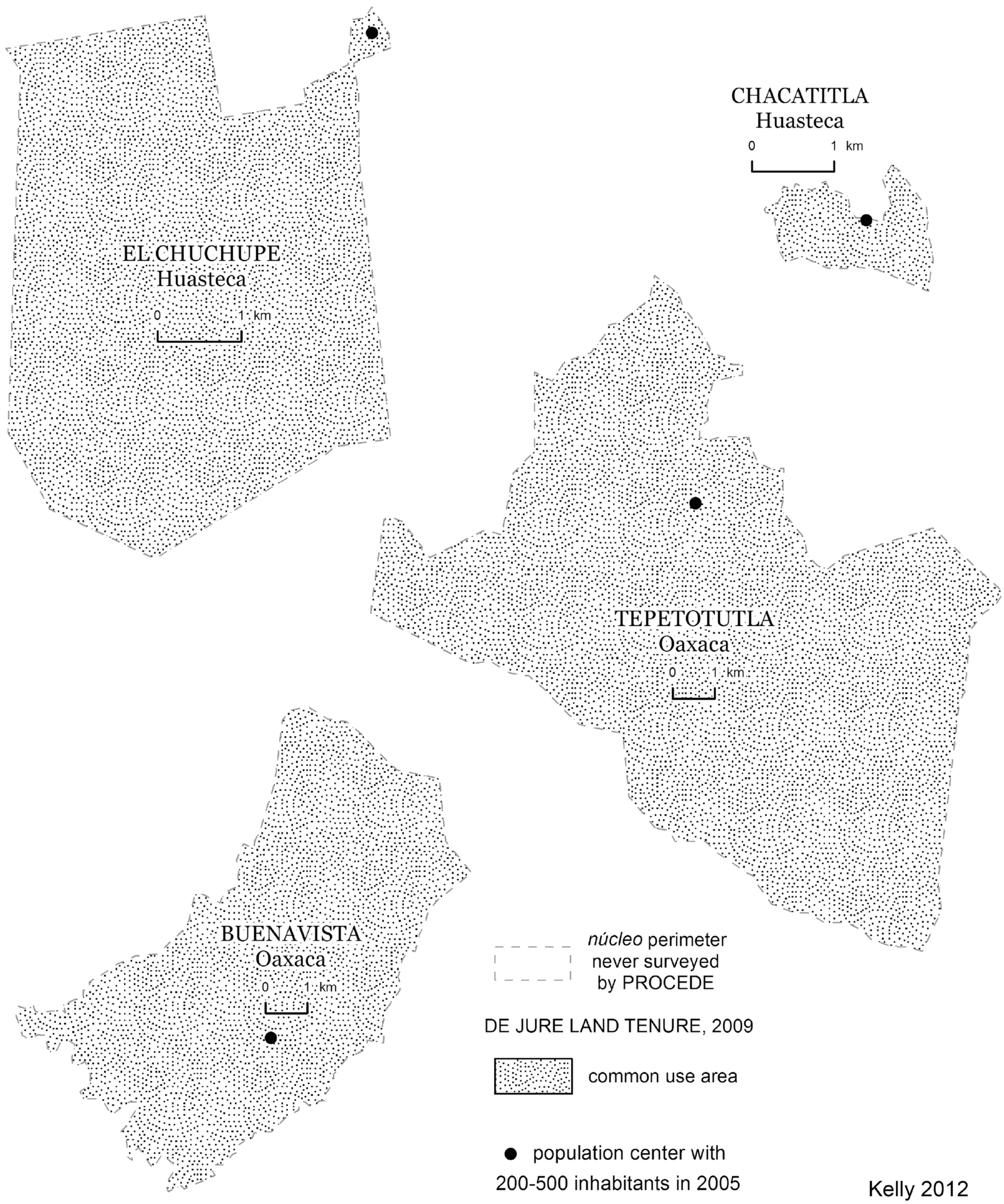


Figure 5.1.2. RAN document study *núcleos*, map 2 (of 9): De jure land tenure areas in 2009. (Sources: RAN archival documents, including PROCEDE maps; INEGI 2011).

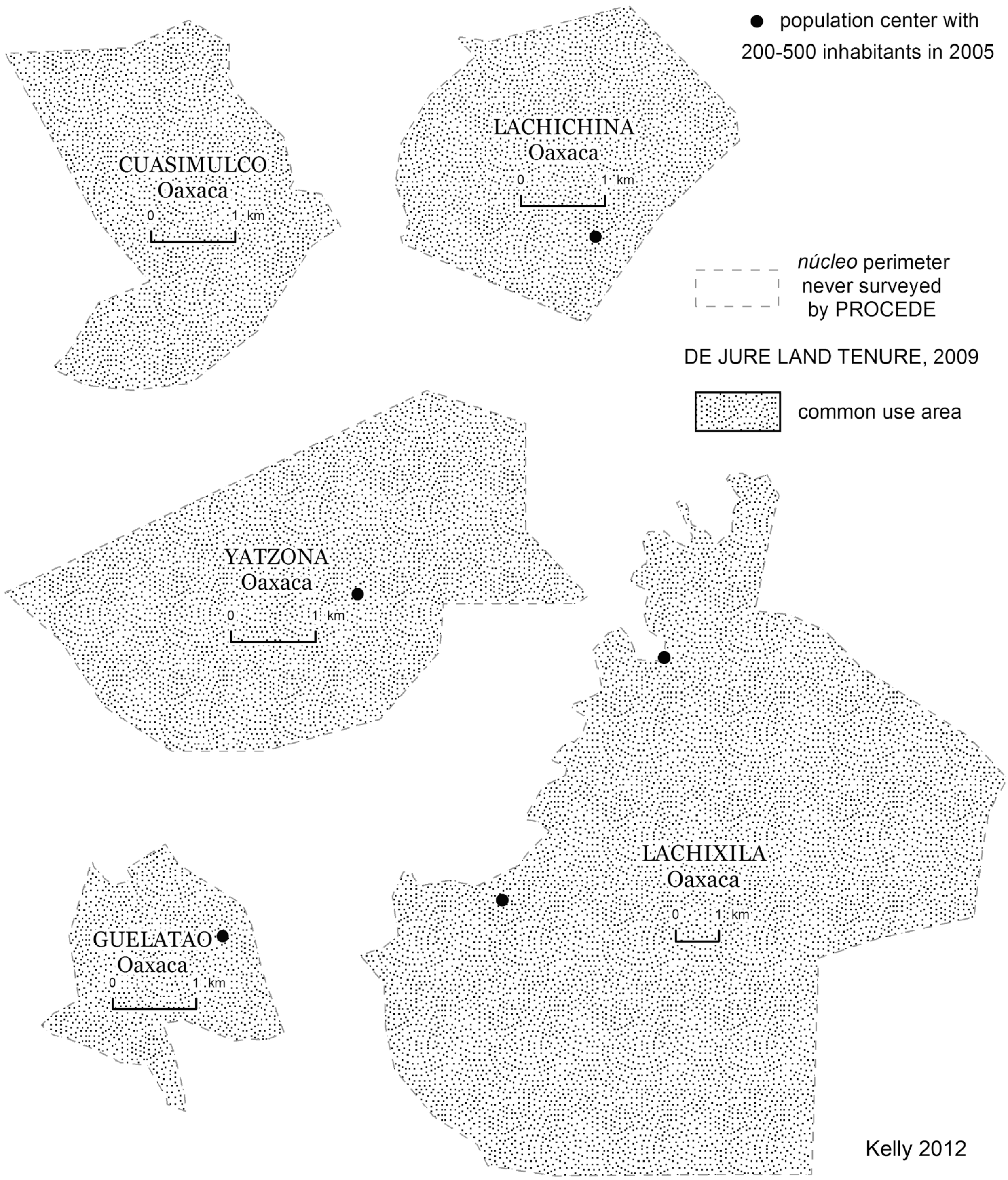


Figure 5.1.3. RAN document study *núcleos*, map 3 (of 9): De jure land tenure areas in 2009. (Sources: RAN archival documents, including PROCEDE maps; INEGI 2011).

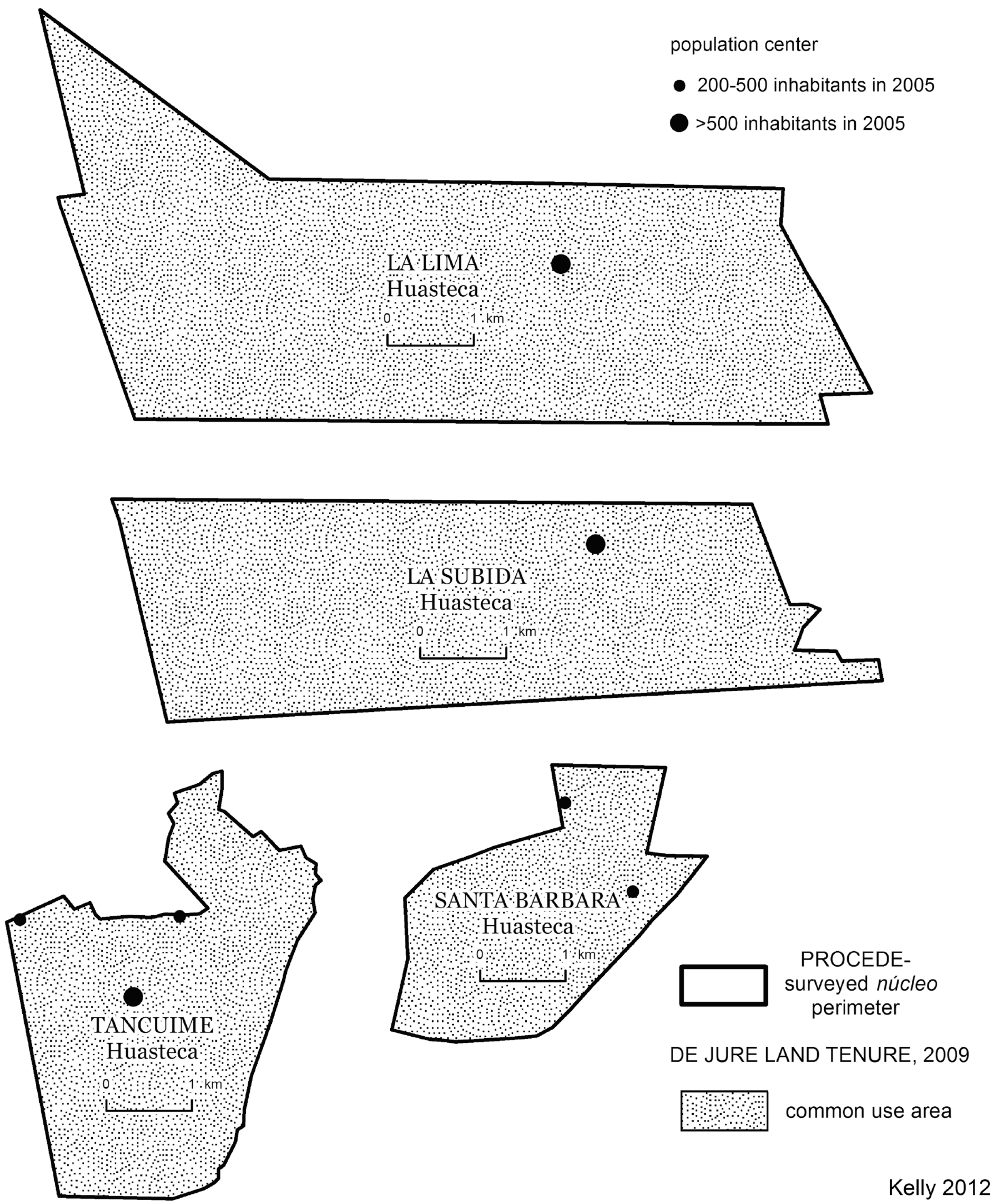


Figure 5.1.4. RAN document study *núcleos*, map 4 (of 9): De jure land tenure areas in 2009. (Sources: RAN archival documents, including PROCEDE maps; INEGI 2011).

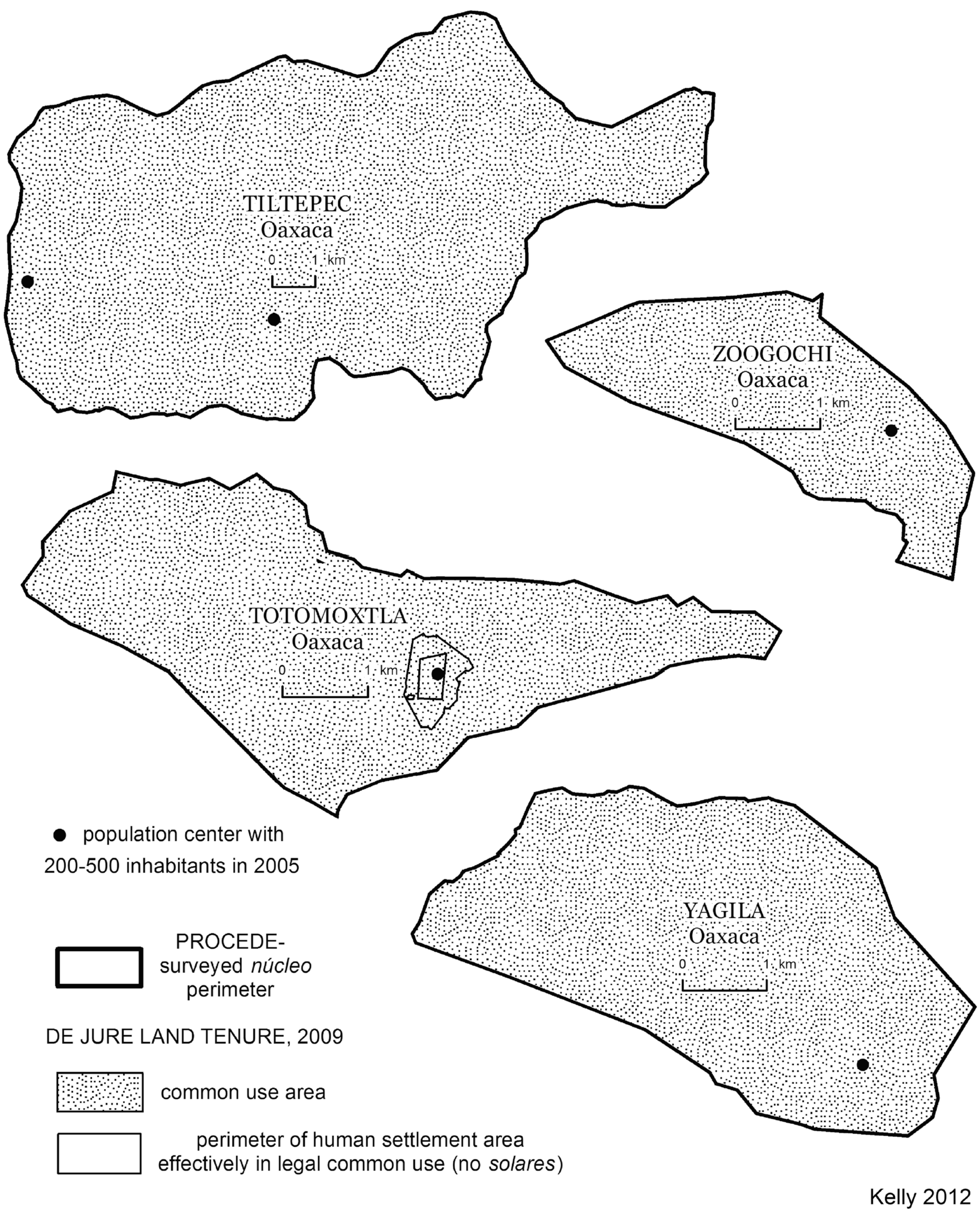


Figure 5.1.5. RAN document study *núcleos*, map 5 (of 9): De jure land tenure areas in 2009. (Sources: RAN archival documents, including PROCEDE maps; INEGI 2011).

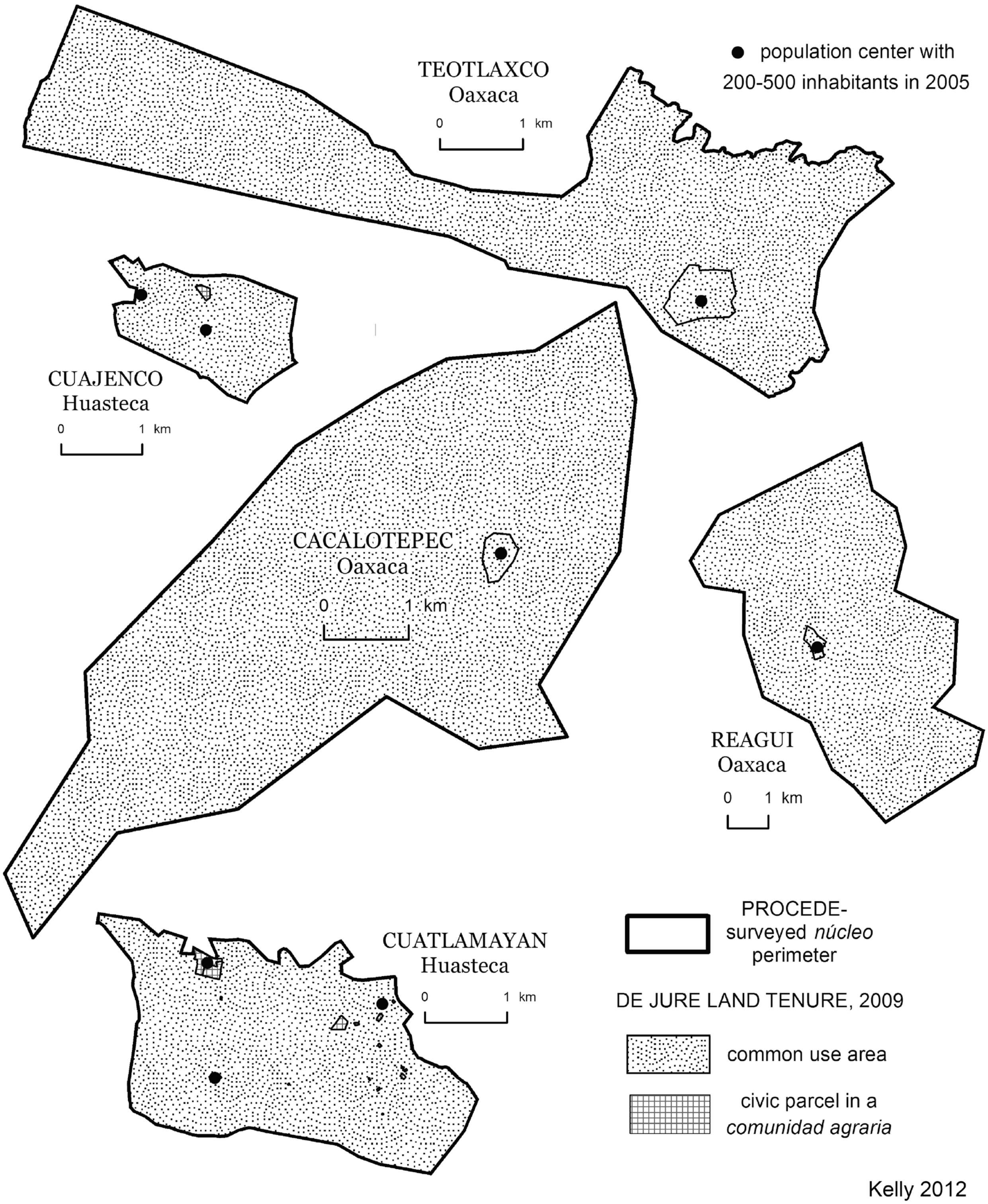


Figure 5.1.6. RAN document study *núcleos*, map 6 (of 9): De jure land tenure areas in 2009. (Sources: RAN archival documents, including PROCEDE maps; INEGI 2011).

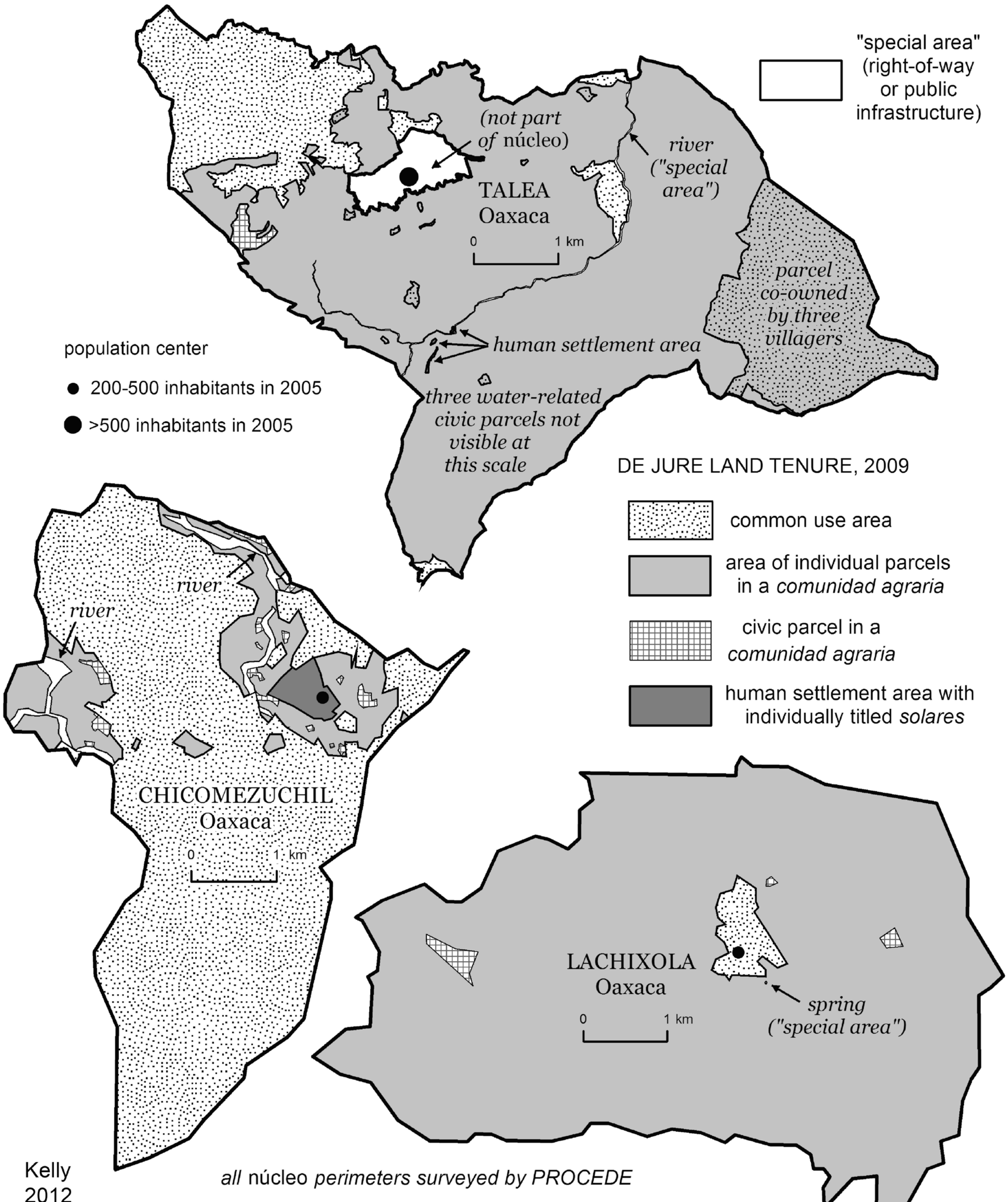


Figure 5.1.7. RAN document study *núcleos*, map 7 (of 9): De jure land tenure areas in 2009. (Sources: RAN archival documents, including PROCEDE maps; INEGI 2011).

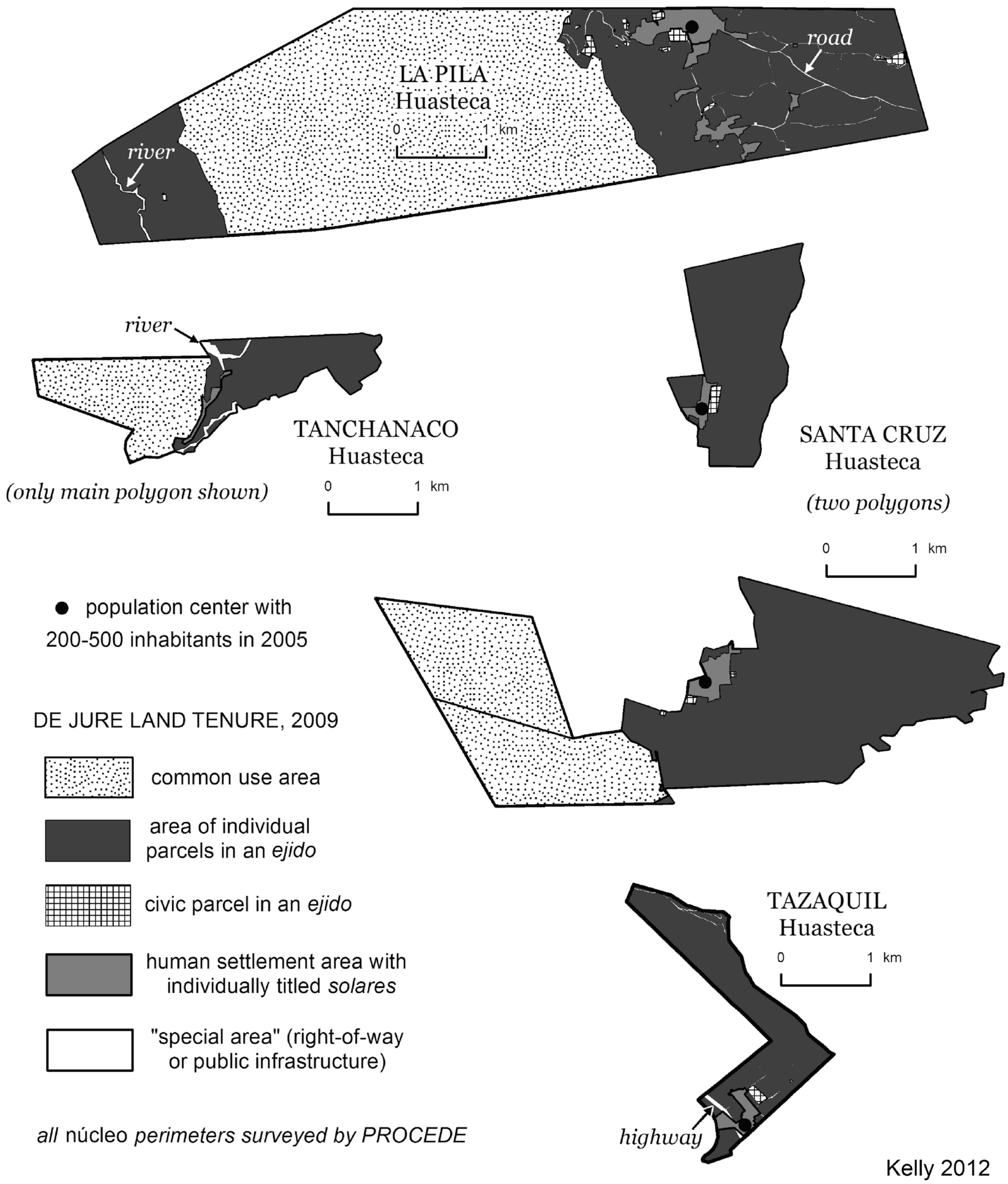


Figure 5.1.8. RAN document study *núcleos*, map 8 (of 9): De jure land tenure areas in 2009. (Sources: RAN archival documents, including PROCEDE maps; INEGI 2011).

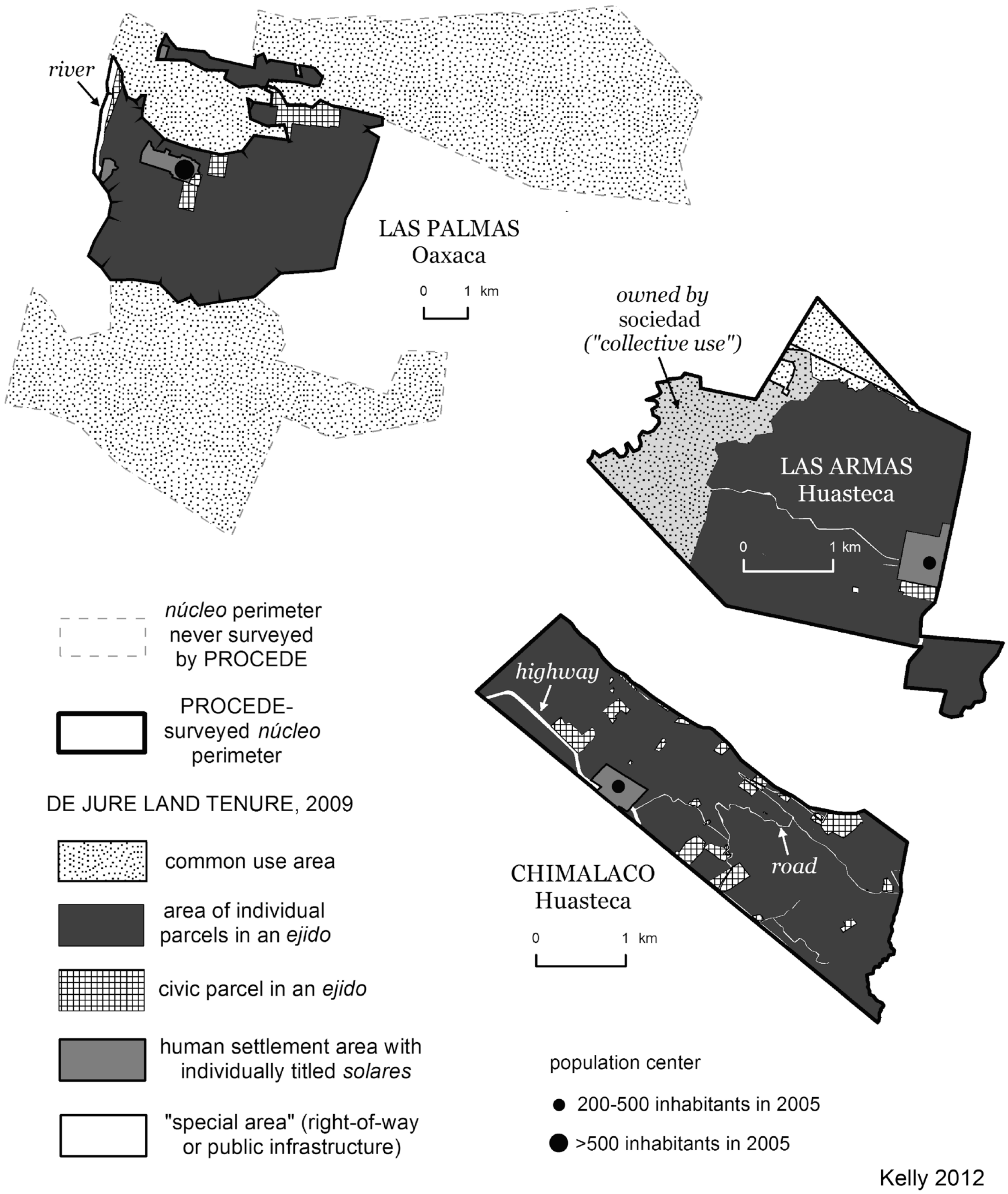
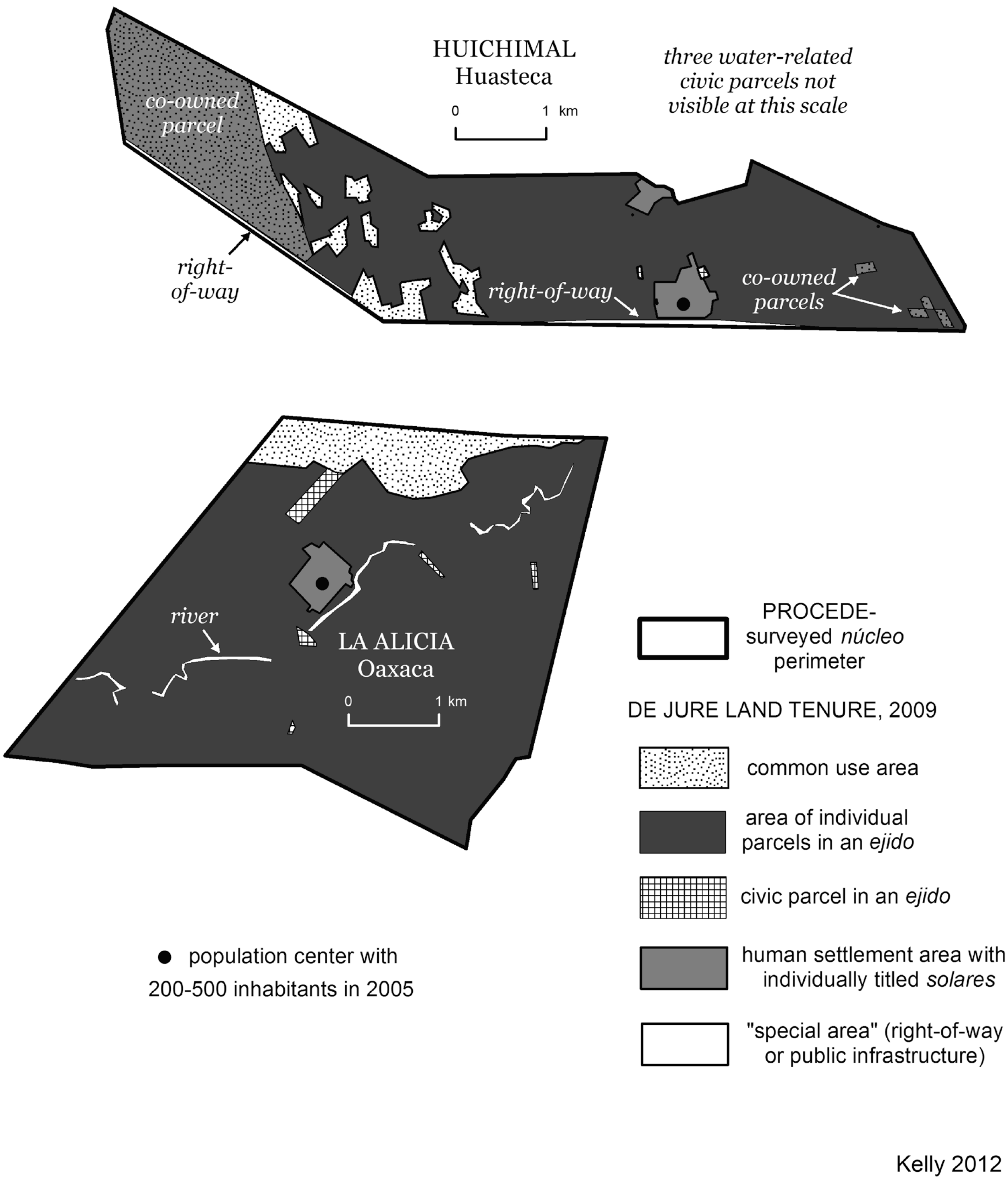


Figure 5.1.9. RAN document study *núcleos*, map 9 (of 9): De jure land tenure areas in 2009. (Sources: RAN archival documents, including PROCEDE maps; INEGI 2011).



5.3 *Water source proprietorship before and after the 1992 reforms*

Only a minor portion of the RAN archival documents mention water issues, but I supplemented these anecdotes with maps and data obtained through participatory research mapping (PRM) and collaborative mapping in 15 of the study *núcleos* (the more detailed PRM results for three of these are presented in chapter 6). The RAN anecdotes tentatively suggest a trajectory slightly different than that found in purely land-related ones. In the case of water, most of the pre-1992 anecdotes show strong village-scale orientation, while there are suggestions of a more mixed orientation after 1992.

Figure 5.4 (on page 216) and Table 5.4 (on page 220) show the relationships between water sources and de facto land tenure areas in Totomoxtla, a Chinantec indigenous *comunidad* where PROCEDE did not survey individual parcels. The proportion of community-mapped water sources in each de facto land tenure zone was compared to the proportion of total land area in each zone. The only unexpected figure was the high concentration of water sources in the tenure category "parceled – urban lots and permanent agriculture."[74] This introduces a recurring theme in this study: water sources which the community consider "important" are likely to be those which are located in or near zones where humans require water – human settlement areas and certain agricultural areas. In other words, the very definition of a "spring," in anything but the most purely hydrophysical context, is inextricably linked to the human beings who recognize its existence and assign it some value. Even relatively "scientific" topographic maps favor springs already valued by humans (chapter 7). This observation is consistent with scholarly works that

[74] Not all important water features are near human-use landscapes, however. The villagers of Nieves, a Chinantec *comunidad* near Totomoxtla, indicated to me that their most sacred site is a pond in the cloud forest at the "saddle point" – the mountain pass furthest from the village center and agricultural area, on the boundary with another community. This sacred site is noted by Bartolomé et al. in their ethnographic study of the Chinantec:

"Though social identification is established with one's village and on some level with one's *municipio*, territorial realms shared by distinct villages are collectively made sacred due to interactions with nature…For the highlanders, Thunder is a living and powerful being [linguistically, it has an animate-classifying numerical article]; people with 'nahua' power can change into this entity. They gather at Cerro de las Dos Cabezas, Mo'tuhdxii, to plan their defense or to attack communities in the form of thunder. They live in the springs on top of the mountains" (Bartolomé et al. 1999, 80).

critically examine the human construction of nature (e.g., Oelschlager 1991; Neumann 1998; Redford and Sanderson 2000; Peluso and Watts 2001; Demerett 2002).

5.3.1 Examples of water-related village-scale and individual orientation before 1992

In Chimalaco in 1930 the *ejido* authorities wrote a letter to San Luis Potosí state military chief, complaining that when the federal social property agency *Comisióthen Nacional Agraria* (CNA) had left it without access to the Huichihuayán River when the *ejido* was formed the *ejido* six years previously. They asserted that the Arroyo Seco ("Dry Creek") bordering the *ejido* was, as its name implied, dry during part of each year, leaving the river, 250 meters away, the only source of water for animals and people. The remnant of the Huichihuayán hacienda had been allowing *ejidatarios* to cross its land with cattle to reach the river, but when the *ejidatarios* returned from the military Northern Campaign, the hacienda stopped allowing this, "causing our complete ruin." The *ejido* requested that the General ask the CNA to intervene on their behalf, to change the *ejido*'s boundary as indicated on a pencil sketch map (RAN 1930). The change was never made, likely encouraging the *ejido* to create its highly developed system of communal *pozos* (shallow wells, usually at or near natural springs), reflected seventy years later in the PROCEDE "civic" parcels dedicated to these water sources.

Community interest in water sources was sometimes expressed as a desire to include specific ones within *núcleo* boundaries during state-initiated surveying programs. In 1975, Guelatao hired an engineer to assert to the RAN that several boundaries in *Resolución Presidencial* were wrong, including a line segment which "leaves outside the community the sources (*tomas*) for potable water, gravity irrigation, and the spray irrigation system" (RAN 1975b).

Any potable water system implies a degree of village-oriented water management, and a lack of one suggests at least some individual orientation. Among the nine Huasteca *ejidos* and *comunidades* studied by the México Indígena team, in only two (El Chuchupe and Tancuime) were reported to lack running household water among household questionnaire respondents. Other *núcleos*, such as Chimalaco and Santa Cruz, have mixed systems, where some houses in the main population center are connected to a shared system, while others have their own *norias* (household or backyard wells). Only one of the nine communities, La Lima, reported that a significant number of households (30 percent) obtained their household water from a public spigot or well, a solution often observed (e.g., in Talea) to be a precursor to a piped shared system.

A few *núcleos* have developed modest agricultural irrigation systems at the village or sub-village scale, although the practice is not as widespread or developed as in drier regions of Mexico. The irrigation canals shown in Guelatao's 1969 parcel map (SRH 1969a) have mostly fallen into disuse. Chicomezúchil has two irrigated zones of about 30 ha each (RAN 1978b), but these are by-products of the water infrastructure built for the defunct textile factory there.[75] Cuatlamayán "is contemplating making a deep well with a pump and tank for the entire community" (interview with Hernández Reyes 2009); due to its dispersed settlement pattern, the same system would serve for both potable water and irrigation. Talea, like several *núcleos*, includes sub-village groups which in essence privately exploit water sources for irrigation, a theme I will return to in Section 6.1. The most highly developed irrigation system among the study *núcleos* is in Las Armas, where water is pumped from the Rio Oxitipa (Coy) to serve a 143-ha "collective use area" of sugar cane. The system is managed by a *sociedad de producción rural*, an entity which conceptually bridges social property and neoliberal commercialism (see chapter 9). These scattered and tentative hints at local water management and rationing traditions may become more common and larger in scale, as the climate changes and export agriculture expands.

A 1969 incident from Cuatlamayán illustrates a general theme that land is considered to be individually owned and water a public good, though the latter should not jeopardize the former. A parcel was being worked by someone lacking *comunero* rights, so the *comunidad* assembly proposed that the *núcleo* confiscate it and then trade the parcel with some *comunero* whose parcel would be valuable to the *comunidad* "for public services, such as electricity or potable water" (RAN 1969c). Thus, the *núcleo* demonstrated its respect for individual parcel ownership – it never contemplated simply confiscating the parcel of a *comunero* in good

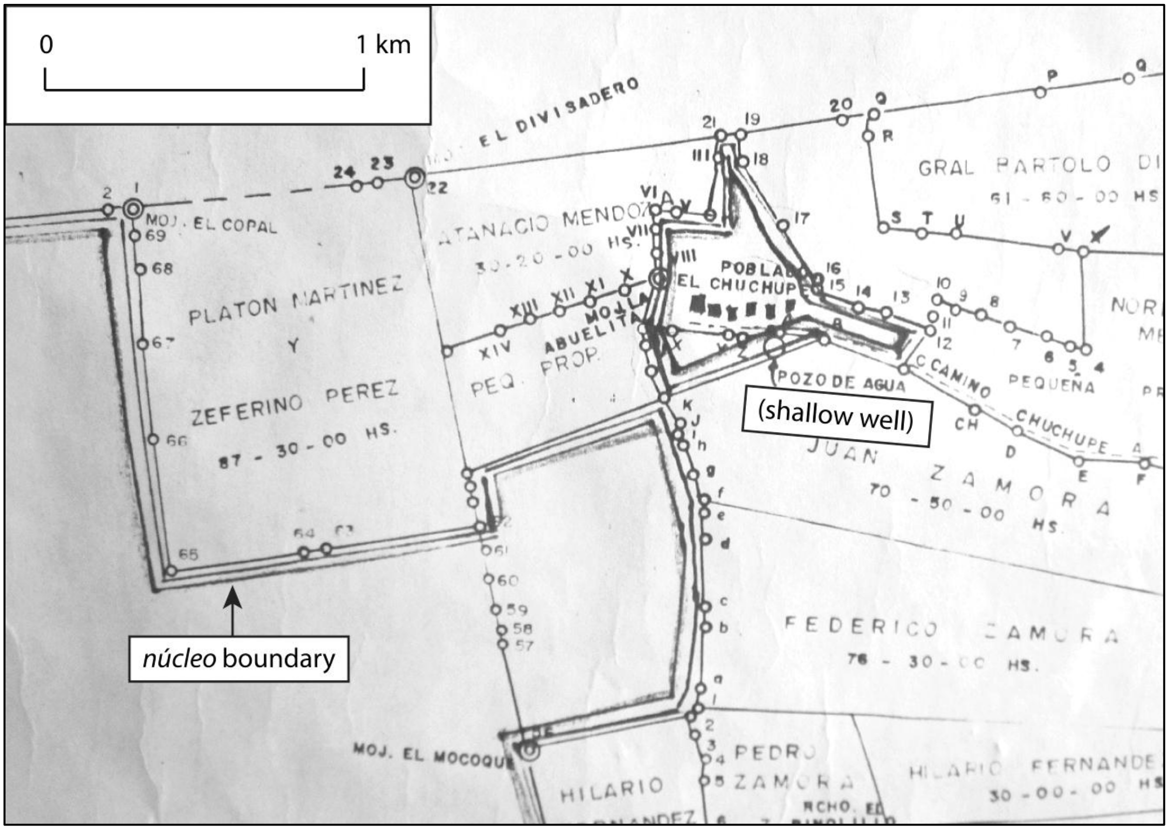
[75] In the late 19th century, the neighboring *comunidad* of Ixtepeji "charged annual user fees for drawing water from the Grillo River, which the factory used for its hydraulic equipment. These lease agreements received much attention by village leaders and eventually became a major source of funding for the town" (McNamara 2007, 103).

standing, even if their parcel contained an important water source – while also showing its interest in promoting the development of a common water supply.

A 1984 event in Lachichina demonstrates both the village-scale orientation of water sources (even, in this case, if located on an individual's *solar*), and the individual nature of much water infrastructure. A *comunera*, Isidora, owned a *solar* with a "*chorro*" (spring or natural pool) called Bej Cuidi, where many families gathered to wash clothes. A *comunero*, Felipe, wanted to build a water storage tank there, and install plastic tubes from it to his house and several other houses. Felipe asked the municipal authorities to help him "invade the terrain," but they refused, because they thought the *chorro* was too small for all the proposed uses, and because it was in the middle of the human settlement area. They accused Felipe of trying to "divide our *barrio* [neighborhood or community] in the manner of a *cacique* [local potentate]," informing Felipe that "no one impedes the use of water because it is a liquid of highest importance for human beings." They suggested he and his friends use water from his *solar* instead. Simultaneously, the assembly passed an *acta* denying Felipe and his friends permission, and that they should instead build their tank next to an existing one, at a different *chorro*. However, this would still require that the tubing to cross Isidora's *solar*. The group did as instructed, but the *municipio* authorities supported Isidora's contention that even the tubing was intrusive, and so the authorities dismantled both the tank and the tubing, despite the *núcleo*'s authorization (RAN 1984-86). A 1954 document from Tiltepec, in contrast, shows how even individual-oriented water infrastructure can belong to the *núcleo*, if it was installed by outside person to whom land had been rented for a specified time (RAN 1955-1958).

Several documents attest to the access of specific water sources as a community right. In Tancuime, letters from the *comunidad* to the government focus on access to streams as community right (Anecdote 1 in the first pages of this chapter) (RAN 1966a). In 1973, the *ejido* of El Chuchupe successfully petitioned the government to have its main population center legalized, though this required condemning parts of several private properties, technically placing the *núcleo* in the category of "New Ejido Population Center." The government survey team was careful to include the village *pozo* (shallow well, likely an enlargement of a natural spring) on their map (Figure 5.2), and to delimit the new boundary so the *pozo* was included in the *ejido*, albeit just barely (DAAC 1973).

Figure 5.2. El Chuchupe: 1973 government map of newly surveyed *ejido* perimeter and neighboring properties (detail). (Source: DAAC 1973).



5.3.2 Village-scale strategies regarding water source proprietorship after 1992

To the degree that the ethos which begat the neoliberal land tenure reforms affect even communities which have not undergone PROCEDE parceling, and to whatever extent the combination of PROCEDE surveying and the modernization of CONAGUA represent a subtle but real change in the state's approach to the land-water nexus in favor of the individual, any post-1992 practice in social property communities which continues or invents a village-scale orientation toward water source proprietorship could be considered a "reaction" or "strategy." I will present examples using the same "strategy" categories, and in the same order, as I introduced them in the first pages of this chapter. I conclude with apparent examples of "no such strategy"; i.e., examples of continuing individual orientation, or moving towards this.

The first strategy is to accept PROCEDE parceling, but with village-oriented, water-related adjustments, most commonly via "civic parcels." To reiterate, civic parcels are those in a PROCEDE-parceled area, not a common use area, whose certified owner is not an individual but rather the *núcleo* itself. Five of Chimalaco's sixteen civic parcels[76] exist entirely for the protection of community water sources (see Figure 5.5, on page 222). They contain four important springs, while the fifth contains a water storage tank for one of these springs (RAN 1995c, 39-48; RAN 1995g, 5). Their land area totals only 0.29 ha (RAN 1995f). These civic parcel water sources only represent a portion of the important *pozos* (modified springs or shallow wells), however. The *ejido* chose to include 17 water sources on the community map it produced during the México Indígena project, 15 of these with distinct Nahuatl toponyms. The four springs chosen for civic parcel status are a mixed bunch, in both physical appearance and use. Two of them have large roofs installed to protect them (but so do two of the non-civic-parcel springs). One of them served a now-abandoned hamlet, Tiaxalo, during the first half of the 20th century, but is now used by only three families, and occasionally by residents of a different *núcleo* (interview with Almendro 2009). Another spring now only used by a few families (for coffee processing) after once having served a different abandoned hamlet, however, is not a in a civic parcel.

One of the civic parcel springs is the source for most of the potable water in Chimalaco's main population center, but the source for the rest of the system is on an individual *comunero*'s parcel. This is apparently "not a problem, and the spring and its tank are maintained by *tequio*" (interview with Salazar 2009). Indeed, "water is taken from all the *pozos*. Even those which have no space [civic parcel status] are for everyone. Even the parcel's owner must respect its vegetation" (interview with Almendro 2009). However, there have been problems of shared maintenance, as discussed below.

Chicomezúchil is the only RAN document study community in the Oaxaca region to include PROCEDE-surveyed civic parcels specifically for water sources (Talea has civic parcels for water storage, not for sources such as wells or springs). Because only five of the 19 Oaxaca *núcleos* had PROCEDE parceling of any kind, the occurrence of civic parcels for water is

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[76] This total does not include parcels "in conflict" or "unassigned," which are also certified, at least temporarily, to the *núcleo*. Most of these will likely eventually be assigned or sold to individuals.

actually similar in the two study regions, at least based on this small sample.[77] Two parcels in Chicomezúchil are assigned to the *comunidad* for water purposes: one is a storage tank, and the other a riverbank access place. There are also two *solares* dedicated to water tanks (RAN 1999g).

La Pila has 14 parcels assigned to the *ejido*, many of them for civic purposes, and of these three are for water purposes: two are reservoirs (dammed ponds), and the third is a tank. Additionally, there are two water tanks labeled as having their own small "parcels" directly on the PROCEDE map, rather than labeled with a number, as all individual parcels are. These are actually "infrastructure areas": rights-of-way not part of any PROCEDE *gran area* (social property tenure class). Like national rivers or highways, which are depicted in the same fashion, these are less subject to village-scale control than civic parcels.

Huichimal's civic parcels include three for community water: one *pozo* (Figure 5.3) and two tanks (*depósitos*) (see Anecdote 4 in the first pages of this chapter). Of the 13 civic *solares* in its two human settlement areas, seven are water related: four *pozos* and three tanks (RAN 2004b).

Tazáquil included one *pozo* parcel among its two civic parcels, although it considers all five of the important, named springs within its territory to be "protected." An incident in Tazáquil suggests that local natural resource regulations may reflect village-scale orientation, but one which was motivated by a common enemy perceived as a threat to those resources. In 2005, the villagers mentioned that "there is no longer any fish, because of pollution from the juice factory which was built in 1988. We were told that the factory would benefit the campesinos, but no, because the factory buys their oranges at a very low price." In 2009, the situation worsened when the plant's "water storage tubing was accidentally broken, chemically contaminating the water supply of Tazáquil," prompting the state's Health Secretary to broadcast by loudspeaker warnings to the villagers that they should avoid drinking their water until the problem was resolved (Martínez Castro 2009).

[77] When I asked the Oaxaca RAN delegate water-related civic parcels were a common practice in the Sierra Norte, he replied that "such parcels are not commonly deeded to community there, because natural springs are so abundant" (interview with Vásquez Córdova 2009).

Figure 5.3. Huichimal: PROCEDE map of parceled area (sheet 2 of 3; detail), including part of map legend. (Source: INEGI 2004).

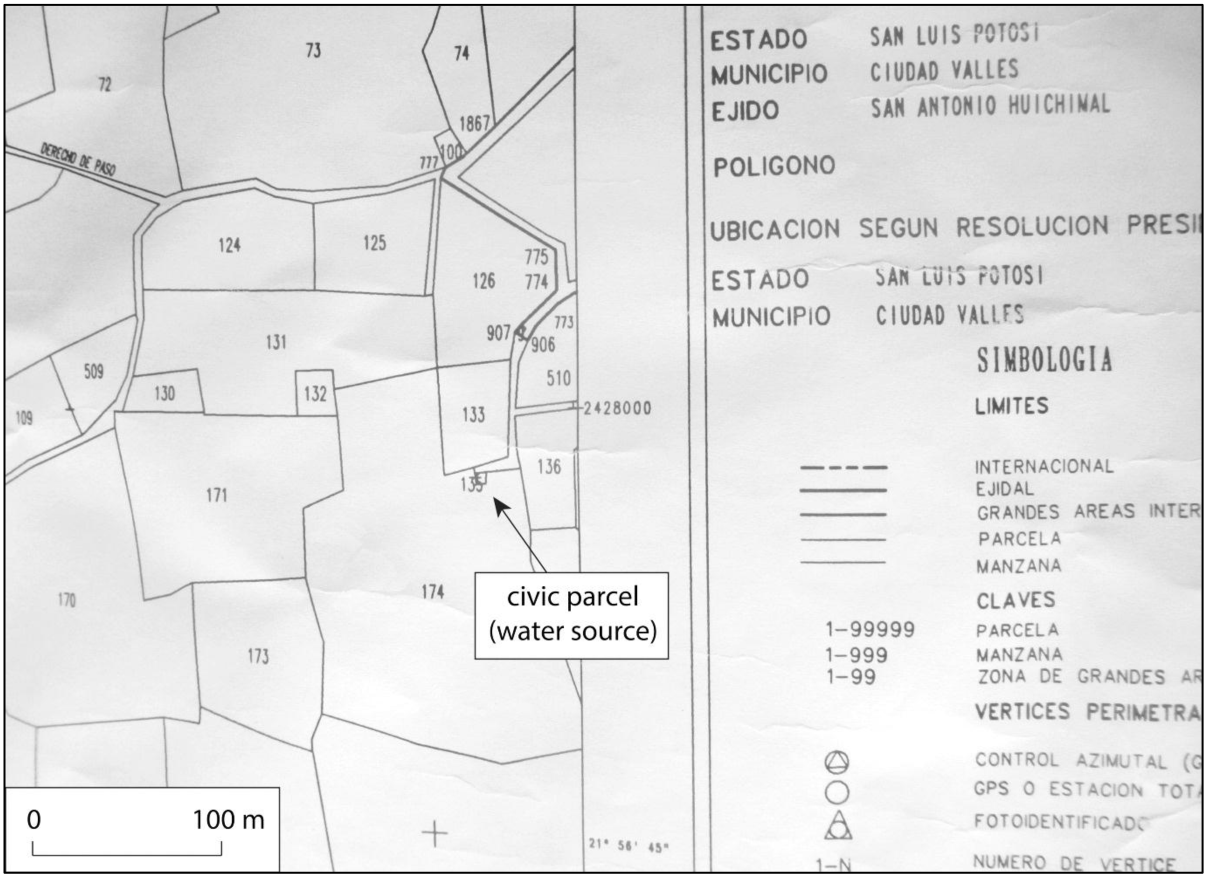


Table 5.2 compares the distribution of locally defined "important springs" among three locally recognized land tenure types in four *núcleos* (see Figures 5.4 through 5.7 below for maps). The three tenure types are "individually-owned parcels," "civic parcels," and "common use areas." Two of the *núcleos*, Chimalaco and Talea, had individual parcels surveyed by PROCEDE; their tenure areas are precisely delimited and legally defined. The other two communities, Tancuime and Cuatlamayán, did not undergo standard PROCEDE surveying of individual parcels, so their tenure areas are defined differently. For Tancuime, I approximated their location and size by combining information from community and parcel questionnaires, the *núcleo*'s participatory map, and my interpretation of air photographs. For Cuatlamayán, which inverted the PROCEDE definitions of de jure tenure areas, the delimitations of the civic parcels

are precise, while the approximate size and location of its tiny de facto common use area is known from fieldwork. For all *núcleos*, human settlement areas or population centers, and any water sources within them, were excluded from the analysis. The springs are those chosen to be included in participatory maps during PRM workshops conducted with México Indígena, and geolocated during the project (México Indígena Research Team 2006a, 2006b, and 2006h), or through my PRM work in Talea.

Table 5.2. Two *núcleos* with PROCEDE parcels, and two without them: Percentage of important water sources in each of three land tenure categories, compared to surface area (as percentage of total) of each tenure category. Figures for Tancuime are approximate (see text); all other figures use precise PROCEDE survey data.

	individually-owned parcels		**civic parcels**		**common use areas**	
núcleo	**% of area**	**% of water sources**	**% of area**	**% of water sources**	**% of area**	**% of water sources**
Tancuime	91	92	<1	0	9	8
Cuatlamayán	99	100	1	0	0	0
AVERAGE - *núcleos* without PROCEDE parcels	95	96	1	0	5	4
Chimalaco	96	71	4	29	0	0
Talea	84	80	1	0	15	20
AVERAGE - *núcleos* with PROCEDE parcels	90	76	3	15	8	10

A clear pattern is that common use areas do not appear to be used as a strategy specifically for the protection and access of important water sources. Some *ejidos* and *comunidades* have large common use areas, others have small ones or none, but in each case the density of important springs within them is about the same as in the *núcleo* as a whole. Civic parcels, in contrast, are used specifically for community water sources, but only in certain communities (e.g., Chimalaco). It may be significant that Chimalaco has no common use areas, and therefore was had special motivation to protect its important water sources in other ways. In other words, typically a village will assign part of its land (or none of it) to "common use," for reasons unrelated to water. If the resulting territory happens to contain an acceptable portion of the *núcleo*'s important water sources, perhaps at least 20 percent of them, then it has no reason to protect more of them via tenure actions such as civic parcels (Talea). If the resulting territory does not contain such a portion of water sources, the community has other options. It may make up the difference by assigning civic parcels (Chimalaco), or it may attempt to maintain village-scale control through persuasion and cultural pressure (Cuatlamayán). Tancuime appears to follow a mixed strategy: a few water sources are in common use areas, but strong local leadership and community culture are probably factors in making up the difference (see below for how this is practiced through maintenance of forest patches).

The second broad strategy "for maintaining village-scale orientation toward water sources is to have PROCEDE survey and certify individual parcels, and to rely on local traditions of oral, tacit, and occasionally written agreements. Santa Cruz underwent PROCEDE surveying of its individual parcels, while maintaining certain village-scale water-related practices (see also Anecdote 5, in the first pages of this chapter). The *ejido* is responsible for maintaining a water supply which it exports to four villages to the northeast. The water is pumped from the Río Oxitipa/Coy, along a stretch with a 40-meter-wide strip of riparian vegetation, and transported by a tube installed with the assistance of the government's nearly defunct Pujal-Coy Irrigation District program (interview with López 2009).

Talea also underwent PROCEDE parceling, but declared its agricultural and forest area (the PROCEDE-parceled *núcleo* of San Miguel Talea de Castro) to be a separate entity from its human settlement area (the unsurveyed "*localidad*" of Villa Talea de Castro, overseen by the county authorities). This highly unusual decision was motivated indirectly by village-scale water issues. According to local informants, one reason for the arrangement was to more efficiently administer the "hinterland," in response to a deadly boundary dispute with the neighboring *núcleo* of Tabaa. This conflict was largely waged over a zone of productive springs in the disputed area (see Figure 6.1 on page 241). A Talea *comunero* asserted that "when I was a child, there were nine *pozos* with water up there in the Cerro de Tabaa, but we lost them with the problems with Tabaa. Now only three have water, because they're far from the village [population center] of Tabaa, and they don't take good care of them" (interview with Velasco 2009).

A third strategy pertains to *ejidos* or *comunidades* which refuse to undergo PROCEDE parceling, and also take actions or maintain practices to encourage village-scale proprietorship of some water sources in ways which avoid a strong spatial linkage between the sources and the de facto ownership of the land where they are located. This, too, relies on maintaining a local culture of respect among individuals and a village-centered ethos. Among the RAN document study *núcleos*, 24 (73 percent) have potable water systems for most or all of the structures in their main population centers. Yagila's system services nearly all the houses in the human settlement area. It consists of separate components divided roughly by *barrio* (neighborhood), with each *barrio* receiving at least some of its water from a different source than the others: "For the potable water supply infrastructure, Barrio Shlaa paid for Raazin [a modified spring]; the whole village, with help from CONAGUA, paid for Yanich [another modified spring]; and Barrio Yajutz paid for Los Sabinos [a third modified spring]. They were paid for by *coopera* [occasional village tax]" (interview with Ramos Francisco 2009). Because only a subset of the springs are located in de facto common use areas (see section 7.2), this suggests some measure of village-scale practice which avoids the legally unambiguous spatial linkages envisioned by the Water Law reform.

Totomoxtla, a highland Chinantec *comunidad* in Oaxaca which did not undergo PROCEDE parceling, exemplifies the complexity of individual and village-oriented land tenure and their relationships to water sources. The analysis presented here is based on the collaborative applied research I conducted in 2003-2004 for a small team affiliated with World Wildlife Fund, and supplemented by interviews conducted in 2009. Figure 5.4 shows a part of the Totomoxtla *núcleo* territory, with three sets of overlapping data: first, important water sources (springs) identified by key informants; second, PROCEDE land tenure zones (in this case, only a legally meaningless "human settlement area"); and third, land tenure zones as understood and practiced by the community. The PROCEDE-defined zones and the de facto areas bear only a loose relationship to each other (RAN 2000d; Kelly 2004).

During collaborative fieldwork, the de facto “parceled” area, as defined by the *núcleo*, was located with GPS. This area includes both *solares* (house lots) in the main population center and permanent, individual farms, some with houses on them, in a ring surrounding this core. In contrast, the PROCEDE map divides this area into three concentric rings:

1. The center – a “donut hole” which is technically just part of the PROCEDE common use area, not its “human settlement area.” In reality, this is an area of densely packed houses and other buildings.

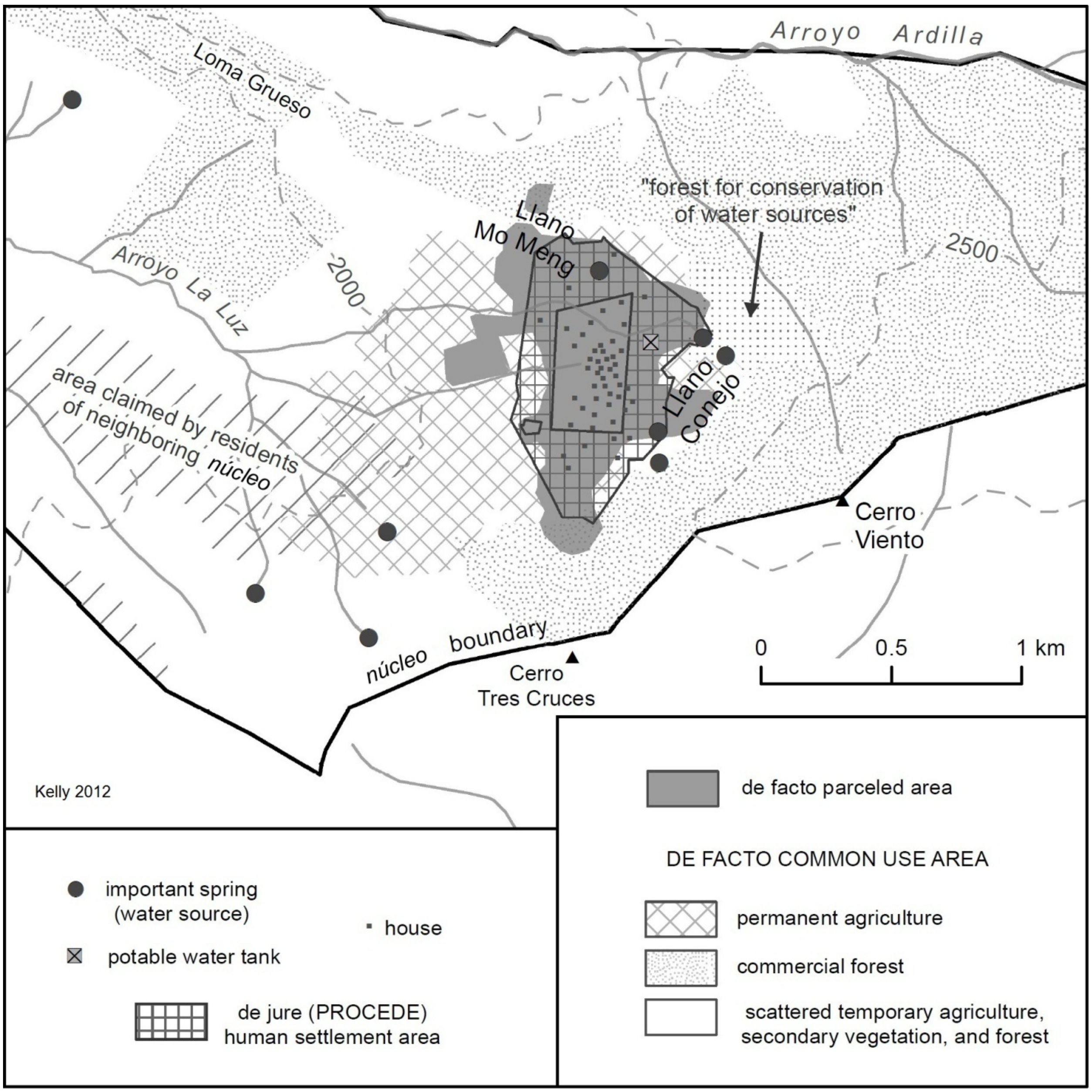
2. The PROCEDE “human settlement area”: In reality, this is zone of larger *solares* verging into dispersed agricultural parcels with houses on them.

3. A few places where the community-defined “parceled” area extends beyond this PROCEDE “human settlement area.”

As a further complication, not even the locally defined tenure zones correspond entirely to the land use patterns observed on the ground. For example, the community’s de facto “parceled area” includes part of the zone of permanent agricultural plots without houses, but not all of this zone. The area of permanent agriculture extends 1 km further west, covering part of the rest of the *núcleo*, which both the community and PROCEDE agree is entirely “common use.” This area is increasingly regulated at the village scale; one *comunero* stated that “before, people would cultivate wherever; but every time we get together, we make more restrictions about where people can cultivate” (interview with Pérez 2009).

The community-defined common use area includes three major land use areas: the permanent agricultural flatland (and firewood-producing forest patches) surrounding the main population center; an “intermediate area” of less permanent, scattered, isolated agricultural patches in a mix of mainly secondary vegetation; and two areas with commercial forestry (the eastern, uphill one is currently productive, while the western, downhill area is a “restoration zone,” recovering from a severe fire). Every *comunero* benefits from the sale of pinewood harvested from the commercial forests, but only a subset of *comuneros* physically manage it Because they are paid an extra share of the profits, the forestry enterprise partly functions like a sub-village *sociedad*.

Figure 5.4. Part of *núcleo* of Totomoxtla, Oaxaca. Land tenure areas according to PROCEDE map (de jure), and according to GPS mapping in collaboration with local residents (de facto), with important water sources identified through GPS collaborative mapping.



A fourth, smaller land use in the common use area consists of "protected areas": a few patches of forest which includes two areas specifically designated to safeguard springs. Before these protected areas had been established, the community already encouraged that a landowner maintain a small grove of trees around one of these springs (CAPLAC 2004b). Two of these protected springs are just above (east) of the population center, in a place called Llano Conejo. These springs are connected to two large tanks and three small ones, supplying about half of the potable domestic water (interview with Pérez 2009). Other sources of the potable water system are along streams arising in the cloud forest/pine-oak forest ecotone (not shown on the map), about 1000 vertical meters above the main population center (CAPLAC 2004b).

Table 5.3. *Comunidad* of Totomoxtla, Oaxaca: Percentage of important water sources in each land tenure/land use category, compared to surface area (as percentage of total) of each category. The first column ("parceled" and "common use") represents locally-defined tenure zones; the second column is observed land use areas within those zones.

		% of area	**% of important water sources**	**relative density of important water sources**
parceled	house lots and permanent agriculture	5	23	4.6
common use	permanent agriculture	6	9	1.5
	commercial forest	43	9	0.2
	scattered temporary agriculture, secondary vegetation, and forest	48	27	0.6
	forest for conservation of water sources	4	32	8.0

A comparison of the density of water sources in each de facto land tenure zone (Table 5.3) shows that important water sources are most densely concentrated in the area of *solares* and permanent agricultural parcels, as well as in the small "protected" areas. In its own way, Totomoxtla shows a similar pattern to that observed in many *núcleos*, in both study regions, regardless of the PROCEDE survey work done: a portion of community-valued water sources (typically, 20 to 40 percent of them) are given some kind of land-tenure-based "protection," while for the rest the village-scale orientation is expressed through established social practices such as oral agreements.

In Totomoxtla, *comunidad* rules stipulate that "we can't cut our trees near four important *manantiales*, even within the [de facto] parceled area" (interview with Pérez 2009). In 2004, the community proposed that "it is an excellent idea to plant fruit trees around the springs where today there are maize fields, to promote retention of high water-capacity soils." However, it should be noted that the rules were enacted with some influence from outreach by a conservationist NGO; and, part of the perceived benefit was to individual *comuneros*, "landowners who would thus benefit economically (CAPLAC 2004b).

In several PRM study communities, including Buenavista, Talea, Totomoxtla, and Yagila, local informants mentioned the maintenance of forested areas or smaller patches of trees to conserve the quality and abundance of water at important springs.[78] Whether the springs were located in de facto or de jure common use areas or on agricultural parcels worked by individuals, this vegetation was seen as a benefit to the community's water supply. To begin to ascertain how often important springs actually have such vegetation in their immediate vicinity, I used the data sources cited in the previous sections of this chapter, as well as my own interpretation of air photographs, to compile a count of each type of spring in four *núcleos* with especially high numbers of locally-identified important springs. Each of the four represents a different type in terms of PROCEDE work: Chimalaco is an *ejido* with PROCEDE parcels, Cuatlamayán is a *comunidad* which "inverted" the PROCEDE template (the only PROCEDE parcels are civic ones), Tancuime is an *ejido* without PROCEDE parcels, and Talea is a *comunidad* with them.

[78] Santos Augusto (2003) documented comparable attitudes in Quiché Maya villages of Guatemala, while Merino (2004, 64) presents an example from Michoacán state, Mexico.

In linking forest cover with water protection, villagers, consciously or not, [79] echo a robust scientific literature which confirms this link in specific, though sometimes not universally accepted, ways. While the benefits of forest cover for water conservation are neither simple nor perfectly understood, riparian and other forested areas have been shown to generate continuous flow during the dry season through subsoil infiltration, in contrast to the rapid surface transfer of water over non-forested land – although this is commonly offset by the increased evapotranspiration through trees (Melville 1994, 72; Bishop and Landell-Mills 2002, 19). Additionally, forests filter sediments and dissolved pollutants, through both the plant issues and the rougher ground (Klapproth and Johnson 2000). Cloud forests, in particular, play an important role in water capture and filtration (Holder 2003). However, *reforested* areas may not act as good water capturers or filters, when compared to "old-growth forests" or even agroforestry patches (Noordwijk, Poulsen, and Ericksen 2004).

Table 5.2 (page 212) showed the proportion of important water sources in these same four *núcleos*, grouped by land tenure categories. Table 5.4 gives the proportion of these same water sources, but now classified by three land use/land cover categories – that is, classes which primarily draw from vegetative cover visible in an air photograph, but also take into account land use and land tenure facts. The goal of this analysis is to begin to determine whether forest patches, including small groups of trees, are being maintained around those water sources chosen by a community as important to them, and whether they are within large forested areas (often corresponding to de facto or de jure "common use areas"), or in an individual parcels.

If a water source is in a small cluster of trees within a working agricultural parcel, it may suggest a village-level policy being followed by individuals, although it may simply reflect an individual farmer's decision purely for their own benefit. As with any classification which

[79] In a study of named springs in a Tzotzil *núcleo* (Chiapas state), it was found that "a powerful reason to maintain a spring is the presence of supernatural beings. It is difficult to discern if this attitude is conservationist, or if it emanates from their beliefs; in any case, it has helped them maintain the foliage around the springs, since they are sacred places. The maintenance of springs is shared, as well as the responsibility to care for their surroundings" (Murillo Licea 2008, 28). The first prominent Western ecologist to sound the alarm about the intertwined threats to water, forests, and land tenure in Latin America was William Vogt, in 1947 (Tucker 2000, 410).

Table 5.4. Four *núcleos*: Percentage of important water sources in each of three land use/land cover categories, compared to total area percentage of each category. (Sources: PRM fieldwork, PROCEDE maps, and air photographs.)

	agriculture		**forest patch in agriculture**		**forested area owned by *núcleo***	
núcleo	**% of area**	**% of water sources**	**% of area**	**% of water sources**	**% of area**	**% of water sources**
Tancuime	80	25	13	50	7	25
Cuatlamayán	85	46	14	54	<1	0
AVERAGE - *núcleos* without PROCEDE parcels	83	36	14	52	4	13
Chimalaco	89	20	11	63	<1	17
Talea	45	0	36	60	17	20
AVERAGE - *núcleos* with PROCEDE parcels	67	10	24	62	9	19

combines land use and land cover, some simplification was necessary. For example, one of Chimalaco's water sources is in a small civic parcel which nevertheless happens to be entirely agricultural (i.e., without trees), but because land cover was prioritized over land tenure for borderline cases in this exercise, this water source was scored as "agriculture." Another challenge was how to score water sources in generally tree-shaded coffee plantations (mainly in Talea and Chimalaco) and other mixed land covers, but in these cases I was usually able to discern groups of mature trees (or their absence) without too much difficulty, aided by my fieldwork experiences in each of the communities.

In Tancuime (and, to a lesser extent, Cuatlamayán), the greatest challenge was in distinguishing de facto forested common use areas from large forest patches in de facto individual parcels. Fortunately, one of the last fieldwork tasks in the Huasteca by the México Indígena team was to convene meetings with key informants in several *núcleos*, with the goal of better understanding the location and management of de facto common use areas. The informants in Tancuime attested that their de facto common use area is the "mountainous area which we call an 'ecological reserve'," which is about 80 percent forested, the rest being naturally unvegetated rocky cliffs and scree slopes. Any forested patches in the flatter area to the east of the mountain range, including gallery forests along incised streams, are within the “parceled (cultivable) lands.” In Cuatlamayán, the local informants stated that “there has never been a common use area in the community, that the entire land [except for the civic parcels] has always had individual owners, that is to say has been parceled, but there is an area for ‘forest resources’ which is totally parceled.” These strips of forest are mainly along the steep west, south, and east boundaries of the *núcleo*, although many agricultural parcels elsewhere in its territory have orchards and other types of intermittent tree cover.

An interesting finding shown in Table 5.4 is that, despite the wide variation among the *núcleos* in most respects, the preponderance of important waters sources in “forest patches in agriculture” is remarkably consistent: between 50 and 63 percent. This is the case even in Talea, where the overall area with this land use/land cover type is much higher than in the other three communities, due to the prevalence of parcels with shaded coffee or pine-oak woodlots. While the sample size is too small to make any firm generalizations, it is possible that social property villages typically try to ensure that at least half of their important springs located in agricultural parcels retain trees and shrubs in their immediate vicinity.

Four maps (Figures 5.6, 5.7, 5.8, and 5.9) depict the spatial distribution of the springs in the *núcleos*. Each spring point symbol is colored black if located within a wooded area, however small, and white if located in an agricultural field or pasture without nearby vegetation larger than shrubs.

Figure 5.5. *Núcleo* of Chimalaco, San Luis Potosí: Locally-identified important springs, with surrounding vegetation (as identified in 2011 air photographs), and PROCEDE-surveyed land tenure zones.

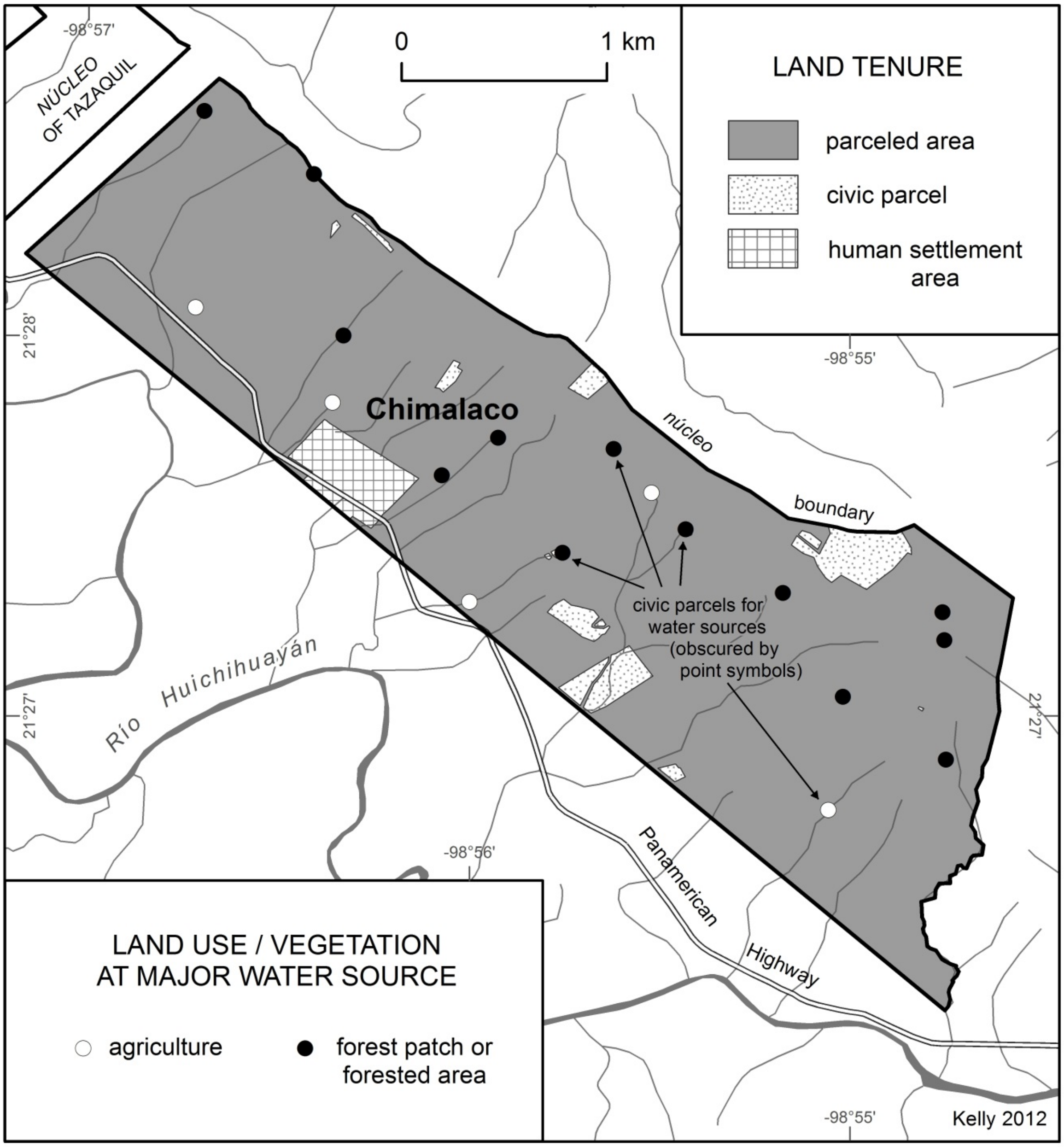


Figure 5.6. *Núcleo* of Cuatlamayán, San Luis Potosí: Locally-identified important springs, with surrounding vegetation (as identified in air photographs), and PROCEDE-surveyed land tenure zones.

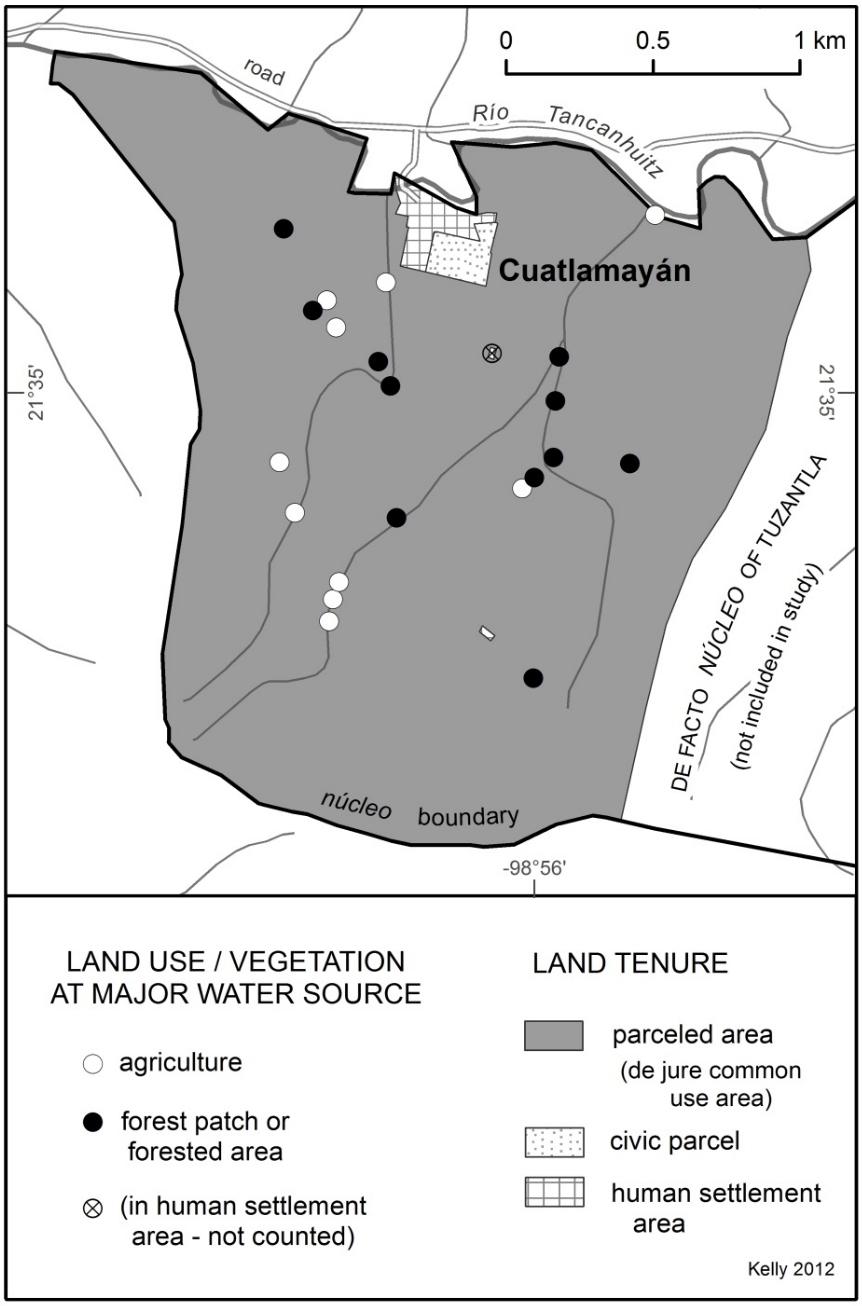


Figure 5.7. *Núcleo* of Tancuime, San Luis Potosí: Locally-identified important springs, with surrounding vegetation (as identified in air photographs), and approximate de facto land tenure zones.

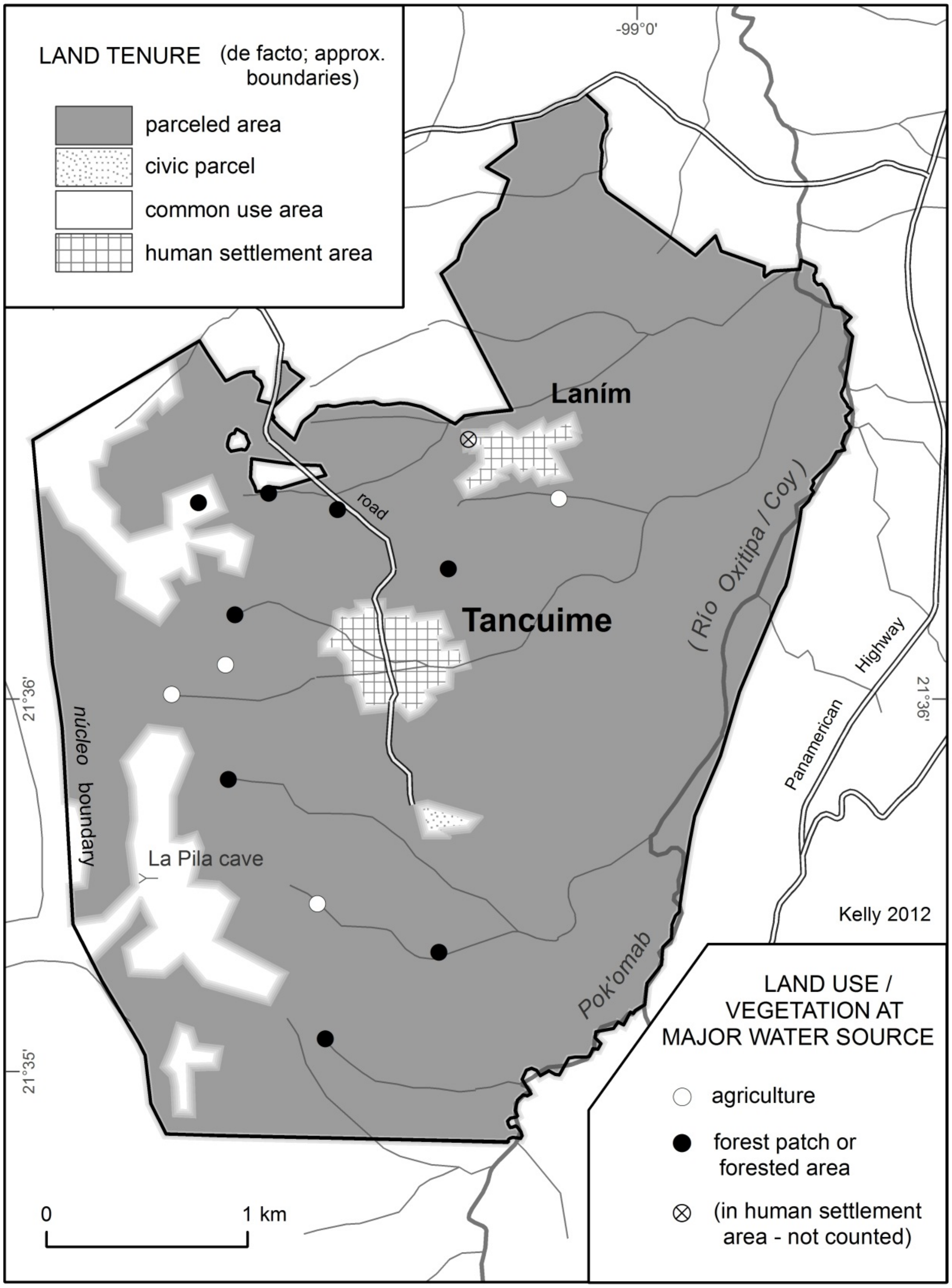
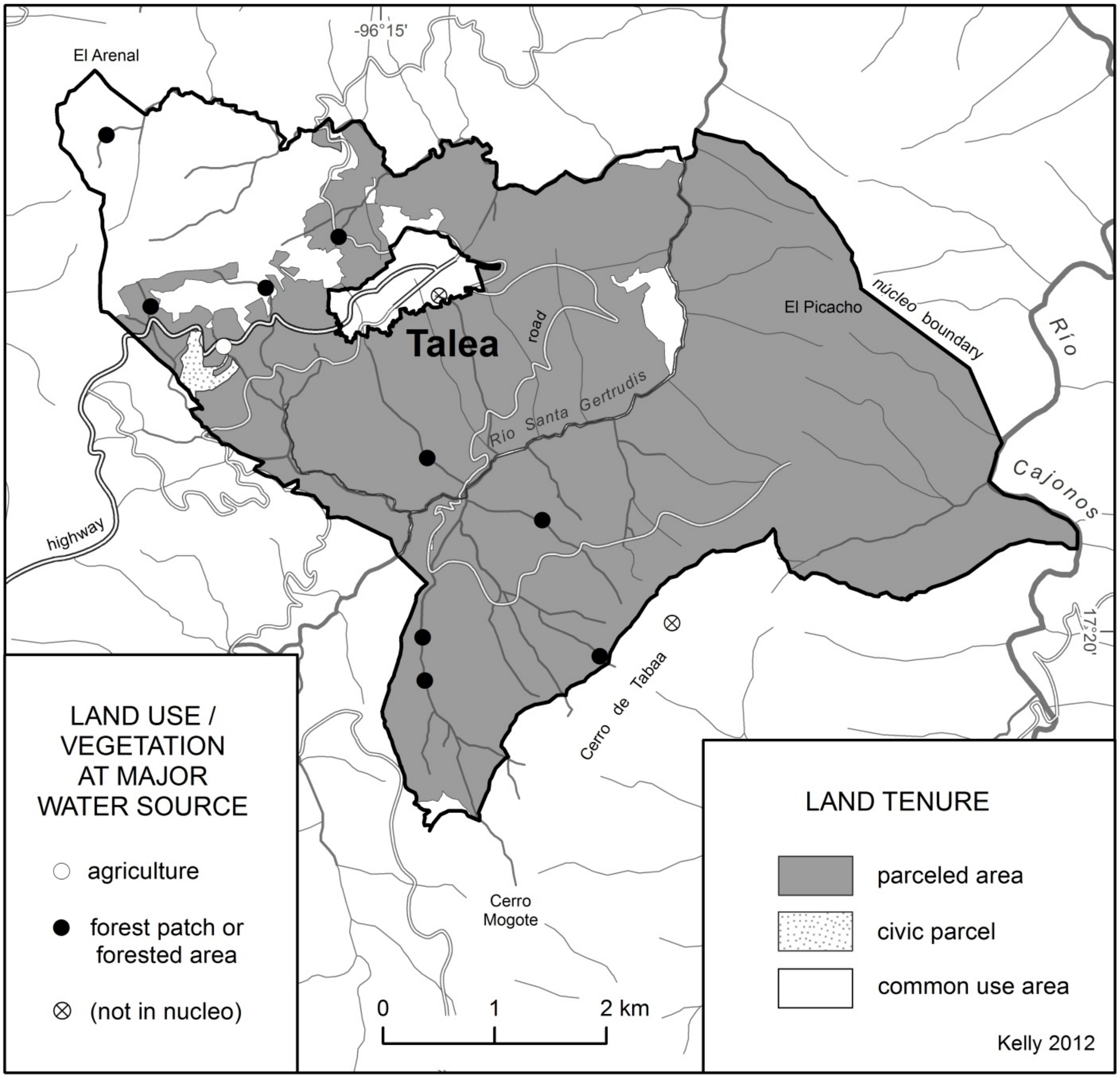


Figure 5.8. *Núcleo* of Talea, Oaxaca: Locally-identified important springs, with surrounding vegetation (as identified in air photographs), and PROCEDE-surveyed land tenure zones.



Some post-1992-reform anecdotes reflect a more individual orientation toward water sources. In Yagila, "there are restrictions on cutting trees near water sources – it's in a statute (*acta*) – but few respect it" (interview with Ramos Francisco 2009). In Chimalaco, "around the

Pochayo *pozo*, vegetation has been cut down. We should expand the vegetated area" (interview with Almendro 2009).

Chimalaco's gradual transformation from a dispersed settlement to a concentrated one, while encouraging village orientation in some ways, has caused several improved water sources to fall into disrepair, including the source of the present-day village supply. "The Ohtlayo *pozo* dries up, so the people there get water from the Taiaxalo *pozo*. The Chiconamel *pozos* lack maintenance nowadays – the tubes tend to get clogged by crud" (interview with Salazar 2009). "The Pochayo *pozo* is almost dry – it wasn't built deeply enough. We should increase the area of protection around it" (interview with Almendro 2009).

In their community questionnaire meeting, the *ejidatarios* of Tazáquil expressed concern that their territory was well located to attract outside land buyers, in part because of its abundant water: "Neighbors and newcomers (*avecindados*) like this place, because of the water and its easy access from the [Panamerican] highway. The *ejidatarios* sell parcels, at low prices, due to their difficult economic situation." To learn whether PROCEDE-certified parcels containing important water sources are being sold at a different rate than other ones, I used the parcel transfer data elicited in the four meetings convened by México Indígena student researchers. An "important" water source is defined here as one which as the *núcleo* chose to include on their México Indígena-assisted community map. I considered four tenure categories (Table 5.5): "individually owned (not sold since PROCEDE)," "individually owned (sold since PROCEDE)," "civic," and "other" (tenure status uncertain). For each tenure category, left-hand figures state the percentage of all parcels in that category, while right-hand figures state the percentage of water source-containing parcels in that category. For this analysis, "parcel" refers to a de jure parcel in a PROCEDE-defined parceled area. Common use and human settlement areas not considered. No distinction is made between "formally sold" and "informally sold," nor between "civic parcels specifically for water purposes" and "other civic parcels," such as for schools.

On average, individual (non-civic) parcels with water sources tend to be sold at about the same rate as parcels in general. However, this average masks great variation among the communities. In Las Armas, the sale of parcels with water sources is substantially less frequent than that *núcleo*'s average sale rate, while in two other communities, Chimalaco and Tazáquil, the sale of water source parcels in substantially more frequent. Chimalaco and Tazáquil (along with La Pila) specifically declared certain water source parcels to be civic and thus relatively shielded from sale. Perhaps this is no coincidence. Having secured a few places as community water protected areas through their PROCEDE survey, these *núcleos* may feel more free to allow market forces to determine the future of those water sources they had chosen *not* to protect in this way.

Table 5.5. PROCEDE-surveyed parcels in five Huasteca *núcleos*: Percentage of all parcels (n=1,390) in each of four tenure categories, compared to percentage of parcels containing important water sources (n=58) in these categories.

	individually-owned parcels				**civic parcels** (all unsold)		**other parcels**	
	unsold since PROCEDE		**sold since PROCEDE**					
núcleo	**% of all**	**% with water source**	**% of all**	**% with water source**	**% of all**	**% with water source**	**% of all**	**% with water source**
La Pila	94	82	1	0	2	18	2	0
Santa Cruz	71	63	22	25	2	13	6	0
Las Armas	82	80	5	0	1	20	13	0
Tazáquil	82	80	3	10	1	10	14	0
Chimalaco	92	66	4	8	4	25	1	0
AVERAGE	84	74	7	10	2	17	7	0

In 2005 and 2006, the México Indígena research team conducted questionnaires with *ejidatarios* and *comuneros* in nine Huasteca *núcleos*, covering topics related both to the household and to the characteristics of one or more of the respondent's individual parcels, about half of them surveyed by PROCEDE. The parcels were located by the local investigators using GPS, assisted by the parcel owners. I found that 38 of the parcels included within them, or at their boundary, a water source (including streams) important enough to be included on a participatory community map. Of the many variables elicited in the questionnaires, I chose nine with some potential relevance to water and land tenure.

Table 5.6. Non-random sample of 115 parcel owners (de facto or de jure) in nine *núcleos* in the Huasteca Potosina: Percentage of parcels with various characteristics than contain or do not contain community-mapped water sources. (Source: México Indígena Research Team).

	% of parcels with mapped water source	**% of parcels without mapped water source**
not an *ejidatario* or *comunero*	6	6
rents out part or all of parcel	17	5
intends to sell parcel "in next year"	6	2
products are for market	67	41
grows fruit	31	29
grows coffee	9	5
grows sugar cane	26	16
has cattle, or grows grass for cattle	17	12
grows maize	23	22

Because of the small sample, only stark differences between water-source parcels and other parcels should be considered as possibly significant. The results (Table 5.6) suggest that water-source parcels may be more attractive for land renters, are more likely to be made available for sale, and more often used for certain market products, especially sugar cane. One observation is that products grown on water-source parcels are more often produced for market (67 percent) than non-water-source parcel products are (41 percent), even though the differences for each specific market product (coffee, cattle, fruit) except sugar cane is negligible. This suggests that the presence of a water source indirectly makes a product more marketable, perhaps because its year-to-year yield is more assured, than the same product on a parcel lacking a water source. In any case, even if the link between market production and water sources is significant, commercial orientation is not necessarily always associated with individualistic attitude (see chapter 9).

Especially strong individual orientations toward water sources were observed in two Huasteca *núcleos*: Santa Cruz, which underwent PROCEDE parceling, and Cuatlamayán, which did not. (Even in these *núcleos*, there is also evidence of sustained village orientation toward water.) In Santa Cruz, each parcel owner has his own small irrigation reservoir (Anecdote 2, in the first pages of this chapter). This individuality of agricultural water supply stems from government assistance programs designed more for private cattle ranchers and cane growers, and from the physical situation of Santa Cruz's parceled area: a gently undulating lowland traversed by three major streams and bordered by a fourth, the Rio Oxitipa/Coy. The most conspicuous cluster of recently sold parcels is around one of these streams (Bonilla 2007), along the stretch that is less than 1.5 km from a paved highway.

Cuatlamayán is unusual among the study *núcleos* in that it has a long tradition of linking water sources to individual parcels, yet it also practices village orientation toward land (e.g., through its "inversion" of the PROCEDE template) and water (e.g., by maintaining a rich density of Nahuatl toponyms for its water sources). Due to its hydrological characteristics and dispersed settlement pattern, the México Indígena household/parcel questionnaires showed that most households get their domestic water from an individual shallow well or improved spring (*pozo*), typically dug about 1 meter in depth. Seventeen of these *pozos* were deemed important enough to be included on the participatory community map, eleven of them with distinct Nahuatl names. Three of the *pozos* have served multiple users. One, near the Tancanhuitz (Tetlakatajko) River that borders the *comunidad,* serves six houses. On a 1969 map produced for the RTBC (RAN 1969d), it is specified as having "communal title," although it is not given special treatment in the PROCEDE map. A second *pozo*, also on an individual's de facto parcel, feeds a tank built in 1996 on the main civic parcel, and provides water for about nine houses (interview with Hernández Reyes 2009).

The third multi-user *pozo,* more of a spring-fed pond, is problematic. Its name, Ueyi Ameli, refers to a local legend about a snake which snake grew too large for the lake, and then emerged from it, carving out the topography of the village territory (interview with Hernández

Reyes 2009). In the 1970s, the *núcleo* installed a tube from this *pozo* to a water storage tank 200 meters away, and another tube from the tank to the school about 1 km further north. When the PROCEDE survey was conducted, once again the tank was included on a small civic parcel, but the water source was left in an individual's de facto parcel. The lack of a de facto common use area (other than a few civic parcels), the fact that house lots in the dispersed settlement are equivalent to agricultural parcels, and the fact the legally all the house lots/parcels are on common use land, all set the stage for a water-related dispute between individual and village interests (Anecdote 3, in the first pages of this chapter). Around 2006, the tube connecting the tank to the school burst. The de facto owner of the parcel containing Ueyi Ameli refused to allow its water to be used for community purposes (interview with Hernández Reyes 2009). This perhaps illustrates the fragility of this "fourth strategy": maintain traditional links between land tenure and water sources, while rejecting PROCEDE parceling, and relying on individual persuasion to maintain village-scale water control. We should not draw broad conclusions from just this one story, and even this story may still have a happy ending. If we were to find similar stories in other similarly situated villages, we might venture to suggest that *núcleos* with an especially robust history of individualized land tenure, but which also wish to maintain deep village-scale cultural practices, may be better off undergoing full PROCEDE parceling, but with adjustments such as multiple civic parcels or small but numerous common use areas.

5.4 Summary of results

Anecdotes from RAN archival documents and from my fieldwork generally show an impressive persistence of village-scale practices in indigenous communities, but more regarding land tenure and rather less when water sources are involved. Coincidentally or not, this may parallel the slow roll out of *dominio pleno* (full land privatization) nationwide through PROCEDE as compared to the somewhat faster modernization of CONAGUA's water rights concession system, although the latter program is still only selectively enforced. Intensive PRM results (chapter 6) will provide detailed examples of how these issues are being mediated in certain indigenous communities, while the geodata analysis (chapter 7) will suggest a broader picture of how great these changes might be, and where they could be most significant.

All other things being equal, there does appear to be some movement toward individual orientation in some communities, and toward deeper entanglement with the systems of the state. To the extent that "indigenous" implies a certain degree of separation from the state – and, less consistently, a certain level of village-scale orientation – this gradual movement does indicate a mild erosion of "indigeneity." However, indigenous communities have always engaged creatively with whatever state claims sovereignty over their territories, and they have always mediated individual and group interests, as any society must do. Most of Mexico's indigenous villages will probably continue to do both these things well into the future, although those which have had their individual parcels surveyed and certified through PROCEDE or FANAR are faced with an extra challenge if they wish to maintain the practice of friendly borrowing of water between individual parcel owners, and between individuals and the village.

The indigenous Chinantec comunidad of Totomoxtla (sub-section 5.3.2) demonstrates a pattern that is remarkably consistent across many *ejidos* and *comunidades,* in both study regions, regardless of the PROCEDE survey work done. A portion of community-valued water sources, typically about 20 to 40 percent of them, are given some kind of land-tenure-based "protection," while for the rest the village-scale orientation is expressed only through established social practices such as oral agreements.

To illustrate this story as it has developed in specific *ejidos* and *comunidades*, I extracted only those 13 *núcleos* for which I had encountered at least five land-tenure-related anecdotes in either the pre-1992 or post-1992 periods. Three of these communities had at least five anecdotes for both periods. As one might expect, village orientation is perhaps slightly more apparent in Oaxaca than in the Huasteca, and more in *comunidades* than in *ejidos*, but these correlations, if they exist at all, are modest compared to the general impression of continued blending and hybridity along the individual-village continuum. I then did the same exercise for water-related anecdotes: I extracted only those 9 *núcleos* for which I had encountered at least three such anecdotes in either the pre-1992 or post-1992 periods. Only one of these had at least three anecdotes for both periods. The sample is too small to confidently characterize by region or by *núcleo* type, though one may observe that Huasteca *núcleos* always included more individual-oriented anecdotes than Oaxaca ones. One general observation, illustrated by the relative stability of Chimalaco's orientation over time and confirmed by the histories of Huichimal and other *ejidos* and *comunidades*, is that interest in community water control is a village-scale issue with deep historical roots. That is, some *núcleos* happen to have a long history of effort in managing their own water sources in certain ways, while others with similar environmental situations have been less interested in this – and that villages more dedicated to community water control will usually find a way to at least partly incorporate this ethos into PROCEDE-era practices.

6. Results, part 2: Individual and village-scale land and water practices in three *núcleos* in 2008-2009

In this chapter I discuss the maps I produced of water-related items and land tenure in the three Oaxaca *comunidades* where I conducted intensive participatory research mapping (PRM) fieldwork. In Talea (section 6.1), I was the sole fieldwork supervisor, in 2009. In the other *núcleos*, Tiltepec and Yagila (section 6.2), I worked with the assistance of the México Indígena research team in 2007 and 2008. The data for Talea are more detailed and complete than that for the other two *núcleos*. The interpretation of these map, along with the RAN archival documents in 33 communities reviewed in chapter 5, as well as the geodata analysis of chapter 7, help to identify patterns and trends in the village-scale control of water sources.

Fieldwork in all three *núcleos* occurred well after the 1992 land tenure reforms. Talea had chosen to have its individual parcels surveyed and certified by PROCEDE, in 2002. The other two *núcleos* only had PROCEDE survey their perimeters: in Tiltepec in 2007, and in Yagila in 2001. Yagila also had PROCEDE survey its "human settlement area," although because it did not have its individual *solares* (house lots) surveyed, this is of little or no practical consequence. Thus, all of the territory in Tiltepec and Yagila is de jure "common use," while the territory of Talea is partly de jure "common use" and partly de jure "individual parcels." However, as is the case with nearly every *núcleo* in Mexico, the territories of Tiltepec and Yagila are similarly divided into de facto "common use" and "individual" areas. De facto tenure areas sometimes have less precise or static spatial boundaries than those defined through PROCEDE surveying. They may sometimes be defined conceptually by the community differently than envisioned by the architects of PROCEDE. Tiltepec and Yagila serve as imperfect proxies for what *núcleos* like Talea were like before they underwent PROCEDE parceling.

The maps for all three villages use the same basic symbology for water-related items, and for land tenure. Individual tenure areas are depicted in gray, and common use areas in white. In Talea, where de facto and de jure categories coincide, the boundaries between individually parceled and common use areas are depicted as sharp lines. One map, Figure 6.7 (page 261), also shows the boundaries of each individual parcel. In the other *comunidades*, the de facto individually parceled and common use area boundaries are shown as "fuzzy" lines, to more honestly represent three facts: in some places, the villagers do not themselves recognize exact boundaries; in some places, even if the villagers do recognize exact boundaries, I was not able to ascertain their precise locations, due to time constraints as well as to ethical considerations; and, in some cases, these boundaries shift over time, something which can happen to PROCEDE-surveyed boundaries only after considerable legal effort.

6.1 Talea: Land tenure and water sources in a PROCEDE-parceled comunidad

After a look at Talea before the 1992 reforms based on secondary sources, I discuss the "natural" water situation as endowed to the village and villagers as the post-reform era began (Figure 6.1, on page 241). I then analyze Talea's water-related items in three separate sets, each pertaining to a different scale of users and infrastructure. The first scale (sub-section 6.1.3) is the *village*; the second (6.1.4) is the *sub-village group*, and the third (6.1.5) is the *individual*. In each case, after I make observations about the water-related items, I consider other practices occurring at that scale. I conclude with a summary of the findings, and consider how generalizable they might be.

Before proceeding with the sub-sections, I will mention one case from anthropologist Laura Nader's 1990 book on municipal and village legal procedures in Talea. The case exemplifies the complex hybrid individual-village nature of the nexus between land and water. Nader (1990, 253) observed how Taleans increasingly recognized the state's ultimate ownership of water:

> Landownership is the basis of power and privilege. Water ownership is conceived of as separate from the land, and although water may be perceived locally as belonging to the community, federal control over water marks the ascendancy of the central government over the community.

A local informant expressed these multiple levels of water ownership to me thus: "The [municipal] water committee is just for the human settlement area – the *comisariado* [*núcleo* authority] is the 'owner' of water for the rest of the community. Sure, all water is federal, but the community is the owner" (Toro Yescas 2009).

Although water is considered separate from land, either of them can be considered as "owned" by individuals. When the land and water exist together in space, this spatial coincidence can be relevant, although the details are sometimes disputed, as attested in a case where water ran from a group of *chorros* (translated by Nader as "waterspouts") to a communal washing area:

> The problem began when Sra. Petra wanted to fix the tank in which the water from a chorro was collected. This she did, ignoring the fact that this chorro was not her property, but rather had been deeded to the community in 1914 by a relative of the people who live near the *chorros*.
>
> When Sra. Petra tried to fix the *chorro*, the neighbors objected because Sra. Petra considered it her property […] When the job was finished, Sra. Petra wanted to charge the neighbors for the job, and they refused to pay…The case could not be settled by the *síndico* [village judge]. It was sent to the *alcalde* [municipal authority], who did manage to settle the conflict, whereby Sra. Petra ceded the job, which had been done for the common good of the neighbors, without any restitution…Later this agreement was ratified by the decision of a federal land agent.
>
> Later, she opened the drainage valve, making it impossible for anyone to do their laundry. She claimed to be cleaning the tank.
>
> The *síndico* 'determined that from this date on and with the purpose of avoiding any more friction between the parties, the cleaning of the spring would be taken care of by the town.' Sra. Petra disagreed […] In the plaintiffs' complaint, it was written that 'it is not known in what way she acquired the domain of her property, constructing her house in such a manner that the water jet is under her porch.'
>
> (Nader 1990, 258-259)

6.1.1 Talea before PROCEDE

In 1964, Laura Nader observed that, in Talea, "a distinction is made between private land and communal land: private land is owned by individuals and may be inherited or sold; communal land may be used for farming by any citizen who asks permission from the town, and this land use may be passed from parents to children but no individual has a right to sell communal land" (Nader 1964, 220). In 1990, she wrote that "it is by means of village courts that the traditional conceptions of collective rights are upheld or destroyed in disputes between group interests and those who adhere to the principle of private ownership. Sometimes […] the property owner comes to see that the public good is the more important and accedes" (Nader 1990, 254). In other conflicts, one party will "frequently mention community interests," while the other emphasizes individualized "written legal documents" – but Nader saw such cases as fundamentally about "personal contest" (Nader 1990, 254).

At the participatory mapping meeting in 2009, I was told by residents that, twenty years before PROCEDE, the villagers of Talea felt compelled to formally apply for status as social property *comuneros*. Before this time, they had considered themselves individual "propietarios" living in unincorporated county (municipal) land, even if not fully recognized as such by the state. The trigger for this change was the "border war" with the neighboring village of Tabaa. In essence, through the mechanism of an RTBC (granted in 1984, with the boundary finalized in Tabaa's favor in 1994), the state offered its services as an enforcer of the village's rural hinterland boundary, in exchange for the village becoming an official *comunidad agraria*. Some saw this as a government intrusion to be endured: "Now we have to ask for permission from the *núcleo* authorities (*comisariado*) to cut trees and such. It's a government policy."

A very early village-scale action relates to both land and water, and is still common knowledge among Taleans five centuries later: "Talea village was originally at a lower elevation, around Sudoh, but in 1525 they moved it to its present location, to be closer to the springs – even though the legend is that someone saw a tree with lights in it there" (interview with Toro Yescas 2009).

As the following anecdote illustrates, in the mid-20th century, communally-used water sources were important locations for the practice of actions to mediate village-scale and individual interests. Nader recounts (1964, 278):

> At the Los Remedios well, each woman in neighborhood has special slab of stone to wash her clothes. One year it was noticed that the water began to dry up. This was blamed on the great amount of bickering and fighting that had gone on at this well. The men's Well Association, created to protect and maintain the wells, had a meeting and decided to renovate the well. They removed all the stones, previously considered private property, and built two dozen cementlike stones for washing. It was stated that no one could own or reserve a space for washing. The priest was then asked to bless the new well and from then on there was water.

The importance of most specific community water sources declined in importance after 1959, when the first potable water system was installed, bringing piped water to houses in the main population center from only a few locations. However, Nader did observe that, even though this technological change "has enabled each woman to have a wash tub in her home, she still prefers to wash at the wells" (Nader 1964, 243).

In 1964 and 1990, Nader stressed the role of several kinds of sub-village groups in the culture of Talea, particularly *barrios*, associations, and churches. Each of these could have some spatial specificity, especially if they owned land in their name.

In Talea, "*barrios*" referred to three "nonlocalized groups" that functioned as cooperative banks or savings-and-loan associations, collected municipal taxes on its saint's day, and could own land (Nader 1964, 236; Nader 1990, 46). She saw them as another example of a shift from individual orientation toward a more community-oriented one. "Associations" were "smaller versions of *barrios*," without official recognition or tax-collecting duties. "As mainly neighboring groupings, they [were] more or less localized," and dominated by women (Nader 1964, 238), except for the music-performing organizations, which "often represent the differing factions in the villages, in particular the enmity and struggle between progressives and conservatives, and between young and old" (Nader 1990, 48). Finally, "like the *barrio* and civil organizations, the various church groupings own property in the form of agricultural land and personal religious property" (Nader 1964, 240). Nader (1990, 49) attributed the proliferation of non-family sub-village groups to Talea's unusual history: "People settled in Talea from other places over time, for various reasons. These people were self-selected for having the will to leave traditional situations."

In the late 1990s, just before PROCEDE surveyed Talea, anthropologist Roberto González found that the *barrios* were still in existence, holding de facto land titles "in common," with "land tenure rights passed down from father to child," but together they represented only four percent of the *núcleo* territory (González 2001, 131). As I will discuss in sub-section 6.1.4, at the time of the PROCEDE surveying work in 2002, none of the parcels were assigned to groups, and only a few to "co-proprietorships," each with a handful of owners. González determined that the *barrio*/association system was "partly broken down" because coffee had been planted on some of the co-owned parcels, and "coffee may not be planted on *barrio* land because coffee trees are long-term plants and groves would effectively become private property" (González 2001, 134), a case of a change in land use inducing a change in de facto land tenure, soon afterwards given legal sanction by PROCEDE.

Like at the village scale, water management at the sub-village-group scale was more tangibly significant before the potable system largely replaced the well system, which depended on multiple specific locations which were both water sources and water use points:

> "We find other formal groupings in Talea, as for example the well groups. All the men whose wives wash at a particular well have an association whose purpose is to maintain the wells and the water supply, and to protect their rights should anyone cut off or threaten this supply of water. These positions are alternated yearly and elected by the neighborhood group."
>
> (Nader 1964, 242)

In sub-section 6.1.4, I will review how the vestiges of sub-village water control have shifted to shared irrigation systems, and to the potable system for the hamlet of Santa Gertrudis.

Despite the strong village identity and preponderance of social property *comunidades*, "the [Sierra Norte] Zapotec's concept of property is based on *individual* ownership" (Nader 1964, 220; emphasis in original). This individual orientation toward worked parcels of land has often been semi-formalized by written records (Gonzalez 2001, 130; see section 5.1 for examples in other *núcleos*). For example, in 1958 a dispute developed between two Talean landowners, when one removed some of the other's coffee plants. Nader wrote (1964, 274):

> Both the plaintiff and the defendant were asked to produce the documents of land ownership. From these, the [municipal authority] determined that the defendant had been in the wrong, and he 'ordered that new boundary stones be set [. . .] The two signed a *convenio* [agreement], and the defendant was fined 40 pesos.

Nader was careful, however, to distinguish between "dyadic" contracts between two individuals, and the practices which mediate between individual rights and community responsibilities (Nader 1990, 6). I discuss this in the context of agreements between parcel owners to share a single water source (sub-section 6.1.5).

Nader (1990, 250-252) cited a legal case which illustrated how water could play a role in the "clash between collective interests and individual ownership." The incident reveals how water itself might be considered a collective good, fundamentally owned by the nation, but that the practices associated with water at a particular location could generate conflicts, with an individual's efforts invested in infrastructure as a key component. A group of Taleans complained that another one would not allow them to "drink water from a river and spring that is on his property":

> We need the water for washing clothes; our women need it. And Sr. Zenon took away the rocks and railing [which they later said they built to protect Zenon's coffee trees]; and we are certain they were there before he bought the land.
>
> Zenon was called to the [municipal authority]. He explained that he had put the rocks there, and that the others don't wash there, they just throw junk there and leave it disgusting. 'For my part there is no permission that they occupy my land because I pay the tax. Those people are abusing private property. I took away the rocks because I am going to plant coffee trees in that place, because it is mine.'
>
> The [authority] said, 'They need that water for their homes.'
>
> Zenon said, 'That is true. If they want to wash, they must take the water to their homes and wash there.'
>
> The others said that 'we don't have the same manner of thinking that he does'; that they had planted banana trees, from which Zenon took the fruit, then killed the trees [. . .] 'Also, with our money we constructed wooden boxes to have water wherever it is needed. He went to uncover them on purpose without our knowing it…He himself invited us to name a chief of the spring so that he and his aides would be aware of whatever was needed. Also, he sold the wood to make the boxes. Also, it was an ugly ravine until we did the work to make it a good, level washing place.'
>
> Sr. Zenon said, 'Why do you want to order my property? Why did you dig without my consent? There is the water, which is federal, but there is no permission for you to occupy my land without my consent.'

Nader wondered, "was [Sr. Zenon] refusing access [for washing clothes] as a way to defend his individual ownership rights, or was he using his rights to the land as a way to force his opponents to work for him? Or both?" (Nader 1990, 253). In any case, the mix of appeals by both parties to individual, village, and national ideals and practices is typical.

González devoted much of his analysis to the practice of coffee cultivation in Talea, including the ways in which coffee farming tended to cement spatially specific, individualized practices,[80] while also adding a new layer of loose cooperative structures, though only weakly identified with the village. He wrote (2001, 195):

> Coffee was introduced in Latin America against the background of older systems of farming [. . .] Talea is a case in point, for it is clear that coffee, in spite of its recent arrival and its Old World origins, is grown in a way that might be referred to as 'traditional'. An exploration of new coffee cooperatives in Oaxaca's Northern Sierra is also part of the story. The cooperatives, institutions structurally rooted in Sierra Zapotec, Mixe, and Chinantec communities, promote organic coffee cultivation based on local techniques that are ecologically sound.

González identified two other ways in which coffee farming promoted group bonding, at two different scales. First, the coffee harvest is considered a "fun family activity," something I, too, was told during my fieldwork. Second, the labor necessary for the harvest often brings together Taleans who live there and those who live elsewhere, typically in Oaxaca City or Mexico City, although the hiring of entirely non-Talean laborers is even more common (González 2001, 212).

Figure 6.1 shows the availability of water in Talea in 2009, during my participatory fieldwork there. It can be compared to Figure 2.7 (page 65), which shows topography and land use/land cover. One must keep in mind that any depiction of "nature" involves various levels of human construction. Figure 6.1 inevitably reveals what is important to humans, particularly in the "areas suitable for shallow wells" (*zonas de pozos*), which may express as much about the locating of human activities for non-hydrological reasons as it does about the water table geography.

The map highlights how altitude is the most important factor in water availability. The large contiguous zone of springs envelops the slopes of Cerro Mogote and its continuation along the Cerro de Tabaa ridgeline to a place called Yab Duá or Yagbdua, Zapotec for "green spring" (INAFED 2007). A second zone of discontinuous concentrations of springs extends below the

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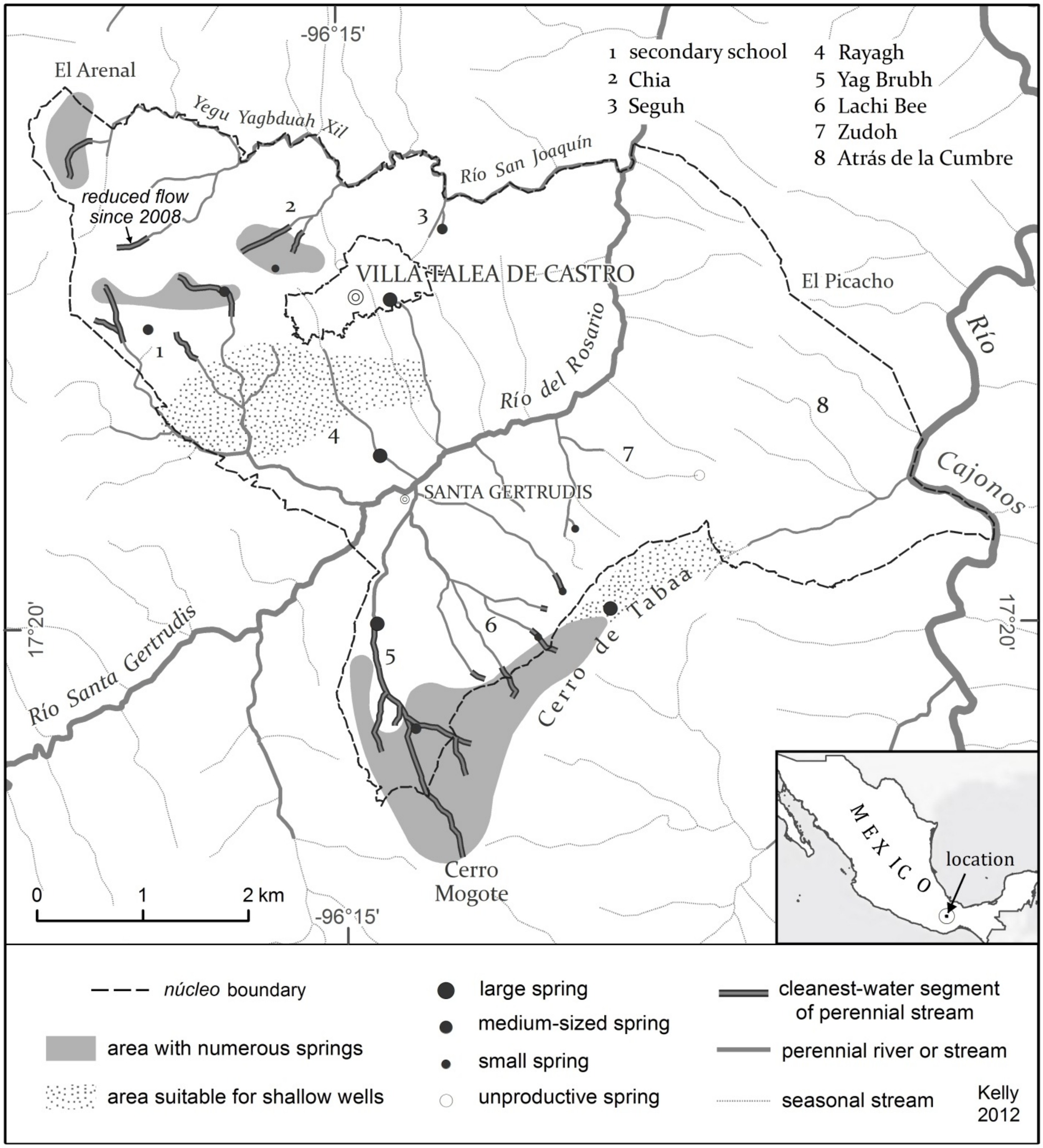
[80] The coffee parcels are individually owned, but their spatial pattern does imply some degree of community orientation: "In the village, coffee cultivation has occurred in a more or less egalitarian manner, on small plots distributed among many households, and thuis replicates a pattern that has existed in the Northern Sierra for years" (González 2001, 225).

Figure 6.1: *Núcleo* of Talea, Oaxaca, in 2009: Water availability ("natural" endowment). (Source: participatory fieldwork).



crest of El Arenal almost to the main population center (Villa Talea de Castro). Although the two zones are at similar elevations, anthropogenic disturbance may be at least partly responsible for the more fragmented distribution of the El Arenal springs. Regional geo-climatic factors also play a role, especially in the lack of springs, and near absence of perennial streams, on the Atrás de la Cumbre ("behind the summit") slope descending to the Río Cajonos.

The high hydrological value of the Cerro de Tabaa ridgeline is evident. As I have mentioned before, "most of this thin strip of forest was lost in a 1991 land conflict" with the neighboring *núcleo* of Tabaa (González 2001, 41). Now, the *comunidad* boundary follows a break in the slope, rather than the ridgeline. This leaves Tabaa with a flat area containing several coffee farms. This area's value to Tabaa is probably even greater than its value to Talea, because the rest of Tabaa's territory faces the Río Cajonos, with the same drier conditions found in Atrás de la Cumbre.

During my fieldwork, I came to realize that springs themselves are regarded as important places, but that many of the actual "*tomas*" – water uptakes for human use – are made along the segments of rivers just below these springs, where the water is approximately as reliably abundant and clean as it is at the springs themselves. With the assistance of my PRM collaborators in Talea, I have included these segments in the map.

In her 1964 book on Talea, Laura Nader included a detailed map of the human settlement area and its immediate surroundings "circa 1960," an area about 2.5 km west-to-east by 2 km north-to-south (Nader 1964, 206). After the houses, the most prominent features on the map are water sources: 15 *pozos* (wells for houses, now all disused except two or three at the edge of the main population center), and five *chorros* ("waterspouts, springs"). Her map has few features in common with my modern geographic layers, as the road network has changed greatly in fifty years. Nevertheless, I was able to georeference the map with enough accuracy to determine that only one of her five *chorros* corresponds to a spring specifically identified during my fieldwork: the Lachi Lagunah spring, visible in Figure 6.1 below the word "Villa."

Another of Nader's 1960 springs, Los Tres Chorros, was the primary water source for the commercial heart of the main population center, and the reason the village was located there in 1525 (González 2001, 39). It is now a paved-over, pumped well half a block from the market square. While it is still used to supplement the water systems of the buildings surrounding it, it was not included in my study, as it is not in any way connected to the *núcleo* territory (which, to reiterate, excludes the urbanized "Villa Talea de Castro"). The third of Nader's springs is in the "area of numerous springs" shown in Figure 6.1 south of Chia.

The last two of her springs were not encountered during my fieldwork. One of these is well outside the urban area, on the coffee-grove-covered slope south of the main population center. Since this is at the edge of an "area suitable for shallow wells," it is possible that the once-natural spring later had to be excavated to reach a locally subsiding water table.

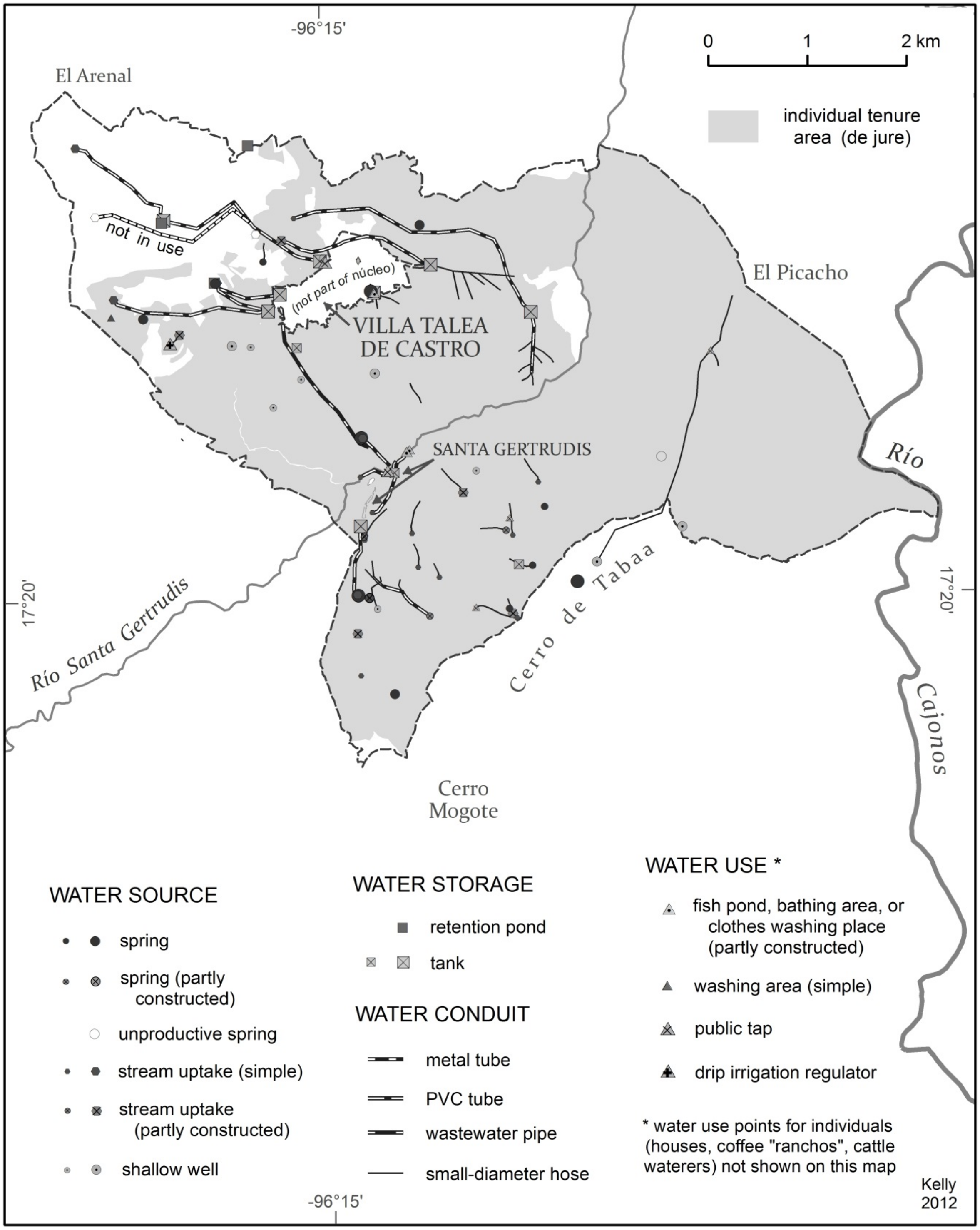
6.1.2 The map of all water-related items, with observations about land tenure

Figure 6.2 displays the location of nearly all the water sources, water transport conduits, and water storage facilities I located during my fieldwork. Water use facilities or locations are shown if they are also water sources (e.g., most shallow wells), or if they are used by sub-village groups, but for clarity, points of individual water use are omitted. The three scales of infrastructure and users (village, sub-village group, and individual) are not identified in this map, but can be inferred by the spatial patterns of conduits.

A notable difference between the water availability map (Figure 6.1) and the water use and infrastructure map (Figure 6.2) occurs at Yag Brubh, an area on the slope of Cerro Mogote. The upper part of this zone has abundant water, yet it is not an especially important area for human water use, a fact confirmed to me during the PRM workshop. There is a small PROCEDE-certified common use area here (the white space at the southern tip of the *núcleo*), but most of the zone is individually parceled and partly planted in coffee, though it is heavily forested. It is poorly located to provide potable water for either of the human settlement areas (the main population center, and the hamlet of Santa Gertrudis), and probably too remote and steep-sloped to be suitable for the water-intensive coffee production, cattle ranching, or irrigated agriculture found elsewhere in the *núcleo*.

The hamlet of Santa Gertrudis, home the 10 percent of Taleans not living in the main population center. The 17 *solares* (house lots) of Santa Gertrudis were surveyed by PROCEDE,

Figure 6.2: *Núcleo* of Talea, Oaxaca, in 2009: Water-related items and land tenure (entire *núcleo*). Tenure types shown are de jure “individual” and “not individual.” (Sources: INEGI 2002b and participatory fieldwork).



but its “area of influence” has no formal boundary surrounding it. As one local informant told me, “its parcels are pretty well mixed up with Talea villager parcels” (interview with Méndez 2009). Santa Gertrudis convenes its own assembly (*asamblea de agencia*), practices its own occasional *tequio*, and is responsible for its potable water supply. Technically, the hamlet is a sub-village group.

At some time in the past century, Taleans began to extend the main human settlement area northward, to an area called Barrio (or Colonia) Vírgen de los Pobres, “founded as a ‘gift’ from the *municipio* to a group of landless folks, in exchange for *cargo* [unpaid community administrative work]” (Toro Yescas 2009; González 2001, 38). After the initial PROCEDE survey in 2002, but before the documents had been finalized, the *núcleo* chose to extend the “*localidad* Villa Talea de Castro” boundaries to include this neighborhood, thus reducing the size of the *comunidad* by 19 hectares.

Talea’s assembly directed PROCEDE to survey six common use areas. The primary one is the forested, well-watered zone above the main population center, up to the summit of El Arenal. About half this area was farmed in maize until 1978, when the village assembly prohibited further deforestation “to prevent forest fires,” though “a few people had deeds [*escrituras*] written up, and they supposedly retain rights to their lands” (interview with Pascual García 2009); hence, some of the forest is today composed of noticeably secondary vegetation. The current local definition of “communal terrain,” according to my participatory collaborators, does not include all of this de jure common use area: there are two places within it still considered as including “individual parcels” (*parcelas particulares*), around which loose cattle roam. Other permissible uses include the gathering of firewood (although this is controlled by the *núcleo*, in order to allow pine trees to thrive), and, in a few places, the cutting of pines for lumber.

Taleans chose to designate five smaller places as additional common use areas. Between Chia and Seguh (Figure 6.3, on page 251) are two zones where “agriculture has been prohibited since the time of PROCEDE, to avoid forest fires, but you can plant maize here or cut wood for personal use, with permission of the *comisariado*” (interview with Pascual García 2009). On the steep, secondary-vegetated slopes of the lower stretch of the Río Santa Gertrudis, here called the Río del Rosario and the Río de Lacal, are two other common use areas, in zones which were impacted by mining and limestone quarrying. The last area is the small zone on the slope of Cerro Mogote.

Talea assigned four PROCEDE-surveyed individual parcels as "civic," i.e., "in favor of the community" (see sub-section 5.3.2). By far the largest of these is the 12-hectare parcel containing the Secondary School, founded in 1977 in the pine woods near the main highway, two kilometers beyond the west edge of the population center. The other three parcels are very small, totaling 0.02 hectares, and contain water storage tanks. One of these tanks is part of the main potable water system, and was included in my fieldwork, while the others have smaller tanks, serving just three and six peri-urban house parcels, respectively.

My final village-scale land tenure observation concerns the "special areas," terrains within the *núcleo* of Talea surveyed by PROCEDE but not included in any of the *grandes areas* (parceled, common use, or human settlement areas). In Talea, there are two types of special areas: public roads, and "rivers or streams" (*ríos o arroyos*). The latter type is discreetly visible on the maps in this chapter as narrow, sinuous white lines of varying width. Only two rivers or streams were deemed wide enough by the PROCEDE surveyors to be given this designation: all of the Río Santa Gertrudis (also called the Río del Rosario in one stretch), and part of the Yegu Yuxhina (called a "nameless stream" on the PROCEDE map). A 5-meter streambed width appears to be the approximate minimum for this legal designation.

These rivers and streams, like the public roads,[81] are locations where the PROCEDE surveyors felt it was necessary to allow the public the right of access, and not just the members of the *núcleo*. If they had not done so, any rights of way later desired for the public good, such as a new public road or electrical utility line, would have to be created either by expropriation (thus removing the terrain from the *núcleo*), or by entering into a contract with the *ejido or comunidad* (if in a common use area) or the parcel owner (if on a certified parcel) for "subjection [*servidumbre*] of passage, rent, and bailment [*comodato*]," or by waiting until the parcels in question had entered a state of *dominio pleno* (full title), at which point they could be purchased outright (CFE 2001, 5). The PROCEDE surveying protocol includes provisions for all types of

[81] In the maps in this chapter, some of the public road and stream rights of way are too narrow to be visible.

right of way on its maps and documents; for example, every parcel certificate includes an area total for the contract class of right of way, though the figure is nearly always zero (Kelly Salinas 1995, 229).

Only two of the water-related items I mapped are located within a "special area" in Talea, neither of them water sources. In the maps and tables, I treat these areas as functionally equivalent to the common use areas. Nevertheless, one should keep in mind that these areas are not legally deeded to the *núcleo*, as the civic parcels are, nor are the deeded to all the *comuneros* or *ejidatarios* at the moment of PROCEDE, as the common use areas are. Instead, they are the first examples of what will gradually become a more common occurrence: land which lies within a *núcleo*'s boundaries, but does not in any way belong to it. It is simply within the *núcleo*'s jurisdictional administrative area. This represents the first clear break in the long-standing unique situation of Mexico's *ejidos* and *comunidades* as both a land-owning entities *and* the lowest-level jurisdictional unit. As PROCEDE-surveyed individual parcels gradually enter into full title, the land-owning role of *núcleos* will diminish.[82]

I will now review the land tenure geography of sub-village groups. The principal observation is that the 20th-century system of landowning *barrios* and associations, already in decline by the 1990s, has not survived into the post-1992-reform era. Taleans could have taken the step of formalizing any of these groups as a commercial *sociedad agraria*, as did the *ejidatarios* of Las Armas in the Huasteca Potosina, and their land would have been certified as "collective use" property. Alternatively, any of these groups could have had their PROCEDE-surveyed parcels certified to multiple owners, known as "co-proprietors." There are eleven such parcels; they are shown as grey areas with black stippling in Figure 5.1.6 (page 200). Several of these probably represent the remnants of old associations, but none have more than five PROCEDE-certified owners. One of these, owned by three women, is by far the largest

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[82] However, the *núcleo*'s jurisdictional role will not increase in turn, but rather diminish as well. The perimeter boundary will fade in importance, as newly privatized parcels fall under the direct jurisdiction of *municipios*, like properties in unincorporated county areas in the United States. Even common use areas will simply be parcels with co-propietors, whose owners happen to be the list of *ejidatarios* or *comuneros* at moment of PROCEDE certification. In nucleos where the process reaches its logical end, the only property that will be owned by the *núcleo* will be any civic parcels it might have had the foresight to assign thus during PROCEDE – although, since the *núcleo* may not function as a viable entity by that point, I assume that civic parcel ownership would be transferred to a larger government entity: the muncipio, the state, or the nation.

individual parcel in Talea: 374 hectares of scrubby secondary vegetation (abandoned farms) in the relatively dry and distant slope known as Atrás de la Cumbre (RAN 2002d). During my fieldwork in 2009, the road from Santa Gertrudis through the coffee farms toward Zudoh was rebuilt after storms had washed it out, and it was also extended to the ridgeline ("La Cumbre") between Cerro de Tabaa and El Picacho (Figure 6.5). I was told that the road construction was a group project by owners of parcels on both sides of the ridgeline, in order to make their farms more accessible and therefore profitable. For the co-owned parcel holders, the road would allow them to re-initiate farming to renters or sharecroppers. Current sub-village-scale associations (sub-section 6.1.4) are composed of owners of individual parcels who join together for a specific purpose, such as shared irrigation infrastructure, without owning any land as a group.

I reiterate that the hamlet of Santa Gertrudis is legally a sub-village group. I have not yet resolved the question of whether, as a group, it is the legal owner of any land. The house lots/kitchen gardens (*solares*) of the hamlet's residents are located in two legally distinct land tenure areas. 15 houses are on PROCEDE-titled *solares* within the human settlement area; this is the thin strip labeled "de jure human settlement" in Figure 6.5. Another approximately 20 houses, however, lie within a single PROCEDE-certified parcel (i.e., in the supposedly agricultural "parceled area"); this is the parcel which appears in Figure 6.7 (page 261) containing the trout hatchery and Nizban Pool. The PROCEDE documents are either incomplete or contradictory regarding the status of this parcel, as well as for an adjacent, uphill, mainly forested parcel. It is not included in the list of Talea's eleven parcels with co-proprietors, nor is it one of the three tiny (water-related) "civic" parcels (RAN 2002d), but neither is it included on the list of parcels assigned to individual *comuneros* (RAN 2002b). Due to this ambiguity, I excluded the water items in this area in calculations for the tables in this chapter.

The land tenure geography of individual parcels presents other complexities. When PROCEDE convened its first full meeting with the community in June 2002, the 1994 RTBC list of 648 *comuneros* was reduced to 468, 100 of whom had died in the intervening eight years while 78 were absent from the meeting and so their rights were suspended for six months. Only one *comunero* was added at this meeting (RAN 2002e). During the PROCEDE activities which followed, 525 non-landowning villagers (*avecindados*) were added (RAN 2002d). This is an unusually high number, and reflects Talea's history as relatively welcoming of newcomers, many of them engaged in non-agricultural work. Of this final list of 993 *comuneros* (RAN 2002e), 704 were certified owners of the 1,637 parcels. The average of 2.3 parcels per owner obscures the fact that *comuneros* have a single parcel, while a few have as many as eleven or twelve.

Parcel boundaries are rarely formally demarcated. Typically, they are marked by subtle vegetation changes which both neighboring owners are aware of. The word *lugar* (place) is used for a named area without definite boundaries, usually containing around ten parcels; in some Zapotec *núcleos*, the equivalent term is *paraje*. The toponyms for these places appear on the participatory community map, and a few of them are also on the maps in this chapter.

Permanent structures are found on two types of parcels: "peri-urban" parcels, and *ranchos*. Peri-urban parcels are smaller-than-average parcels located in three places just beyond the boundaries of Villa Talea de Castro; another group of six is visible in the Santa Gertrudis hamlet, in Figure 6.7. These are places where a human settlement area has expanded beyond its former boundaries. The other type of structure built on parcels, the *rancho*, is much more common. These are buildings used for storing maize, processing coffee beans, or other farm activities; many once included sugar cane presses, but these are now uncommon (interview with Méndez 2009). There are over five hundred *ranchos*, distributed throughout the *núcleo*. Many are built so robustly, and with the same aesthetic attention paid to the human settlement houses, that the cartographers who created the INEGI 1:50,000-scale topographic map marked them with the symbol usually reserved for permanent domiciles. These structures represent a significant investment, attesting to the enduring link between a parcel and its owner (and the owner's heirs), but are locally recognized as not being "houses" because the "lack electricity" (interview with Pascual García 2009).

There are a few areas, such as Seguh (Figure 6.5, on page 257), which contain PROCEDE-certified individual parcels, but where farming is generally no longer practiced. Such parcels are typically abundant in "*ocote*" pine trees (*Pinus ayacahuite* or *P. montezumae*). After obtaining permission from the *núcleo* authority, owners of these parcels sometimes contract a local resident who owns a chainsaw to cut a few trees for timber, for themselves or for a few friends and neighbors (interview with Toro Yescas 2009).

6.1.3 Village-scale water-related items in Talea

Village-scale water items (Figure 6.3) fall into two categories. Most sources, conduits, and storage facilities are part of the potable water system which serves the houses and businesses of the Villa Talea de Castro population center.[83] The second category consists of a few water sources where water is still used *in situ* by the community. I will discuss this second, smaller category first.

The "*Manantial* Lachi Lagunah" (Figure 6.4) is a productive spring in a well-shaded neighborhood near the edge of the settlement zone. Next to the natural spring, behind a retaining wall, is a large, partly-roofed cement tank with an open upper surface for storing its water. This is used to provide water to a few coffee-producing *ranchos* nearby, and by several dozen households for washing clothes, as well as for emergency provision of water to the potable system. On orders from the municipal authorities (not *núcleo* authorities, as it is outside the boundaries of the *comunidad*), the surrounding vegetation is "protected" (interview with Ribero 2009). In 2009, to supplement or replace the existing wastewater pipe at the western extreme of the main population center, construction was initiated (with CONAGUA's assistance) on a wastewater pipe which will collect effluent near this spring, and treat it at a plant about 1 km downslope, along the Guiax Pquíz stream.

One other village-used water item unrelated to the potable system is shown in Figure 6.3: a small rock weir which forms a swimming hole, along the Yegu Yagbduah Xil stream, where the road to Yatoni exits the Talea *núcleo*'s territory. I included this item to represent the approximately dozen simple modifications of streams, scattered across the *núcleo* near important roads and paths, which are used occasionally by anyone for washing, bathing, or drinking.

The potable water system for the main population center is maintained by CONSAP, a water committee with its own small office separate from the *municipio* administration. Each household pays it 50 pesos per year. The committee is in charge of making sure the storage tanks are kept clean, and its members take turns guarding the water sources and tanks against

[83] Due to Talea's unusual "donut" legal configuration, this is technically an example of water transport which crosses *núcleo* boundaries. Because the domestic users of the "donut hole" are the same people as the landowners of the "donut," this fact is unimportant, although it conceivably could cause problems in the future.

Figure 6.3: *Núcleo* of Talea, Oaxaca, in 2009 – Village-scale infrastructure/users: Water-related items and land tenure areas (map shows part of Talea *núcleo* territory). Tenure types shown are de jure "individual" and "not individual." Sample is almost 100 percent of village-scale items in Talea. (Sources: INEGI 2002b and participatory fieldwork).

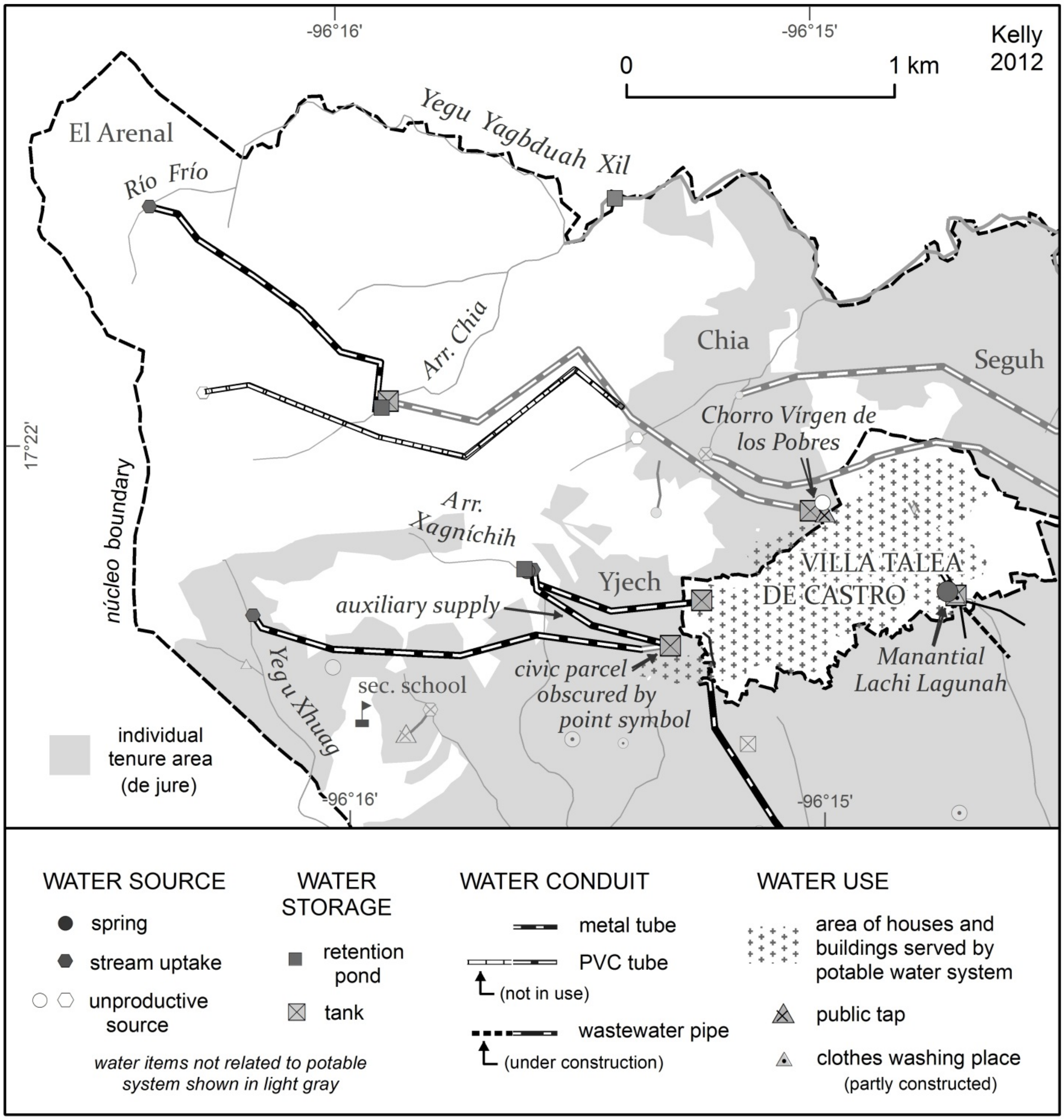


Figure 6.4. *Manantial* Lachi Lagunah, a spring, water tank, and public basin at the outskirts of the main population center of Talea, Oaxaca. It is one of the few remaining locations of for *in situ* community water use, and the only water source serving both agricultural parcels and, in emergencies, the domestic potable water system. (Photograph by the author in 2009).

infractions such as dumping garbage. They periodically check the tanks to make sure they don't completely empty; if they do, a local plumber is called to fix the airlock which this causes (interview with Pérez Cruz 2009). Before the 1970s, *tequio* (obligatory communal work) was a more active village-scale practice, and one of its tasks was "to recondition the public water supply and drainage system" (Nader 1964, 242).

There are four locations currently functioning as potable water sources feeding into the system. Each consists of a stream uptake 150 to 400 meters downstream from the spring where a permanent stream arises. Typically, these uptakes were constructed as small concrete tanks through which the stream passes, surrounded by wire mesh as a filter. In two of the locations, a small dam had been built to form a pond (interview with Pérez Cruz 2009). A fifth uptake, built in 1991, fell into disuse in 2008 when its stream became dry for most of the year.

Two of the uptakes are well within the large, forested common use area.[84] One uptake, along Arroyo Xagníchih at a permanent spring, is surrounded by barbed wire, to keep cows away. While it is within the common use area, an individual's parcel is located only 50 meters away and uphill from the uptake. I was told that this parcel was planted in maize until 1986, when it was "taken from the owner and given to the community, in exchange for another parcel, to prevent agro-chemicals from contaminating the water." However, the 2002 PROCEDE documents show it as still certified to an individual – an unusual discrepancy between de jure and de facto land tenure in Talea.

The fourth productive uptake for the main population center's supply is located well within a PROCEDE-certified individual's parcel, near the source of the Yegu Xhuag stream. A second uptake, serving the secondary school nearby, adjoins it. The land here is well forested, including some cloud forest species. I was told that not even the parcel owner is allowed to cut down trees near the water uptake, although this dictum is not always followed: another *comunera* attested that "several springs around edge of settlement area have dried up because they lacked maintenance – vegetation was cut down" (interview with Méndez 2009). One local leader told me that the village-scale power over any local landowner in potable water supply matters was linked to the fact that the state grants the concession to the community as a whole: "It's no problem if some [potable supply] springs are within parcels, but CONAGUA gives concessions to the *ayuntamiento* [*municipio* authority]. The people with parcels know they can't refuse [*negar*]" (interview with Pérez Cruz 2009).

The conduits which bring water from these sources to the storage tanks near the main population center include metal pipe (in some segments buried, in others suspended on brick columns), or PVC tubing for segments installed since 1987 (Archivo Histórico del Agua 1970).

[84] Also within the common use area is a "lake once considered sacred – a place where you give thanks to the rain" (interview with Pascual García 2009). My local collaborators brought me near the site, but not precisely to it.

Three tanks at the edge of the main population center store the potable supply. One is located on a small "civic" parcel, and another is well within the "donut hole" of Villa Talea de Castro. The third tank, located just within Villa Talea, is Chorro Vírgen de los Pobres. This is the most interesting and aesthetically pleasing water-related site in Talea. It began as a natural spring above the main settlement area. When the Vírgen de los Pobres neighborhood was developed for new residents sometime in the 20^{th} century, a beautifully constructed rock, concrete, adobe, and wooden structure was built to channel the spring's water into a roofed, hard-floor, open-walled tub to facilitate their water needs, both *in situ* (e.g., washing clothes) and as a source for hand-carried domestic water. Even after the population center's potable system was installed in 1959, the structure has continued to be used for water activities, probably in part due to its social function as a gathering place. In the 1980s, the spring had become unproductive. At about the same time, the Río Frío section of the potable supply system was constructed, including a storage tank built as an extension of the Vírgen de los Pobres structure, thus fortuitously maintaining the site's role as an active village water feature.

In 2006 schoolteachers working in Talea and neighboring villages initiated a proposal to revive mining in the *núcleo*, after a Canadian mining company had explored the possibility in 2003. In an expression of village-scale water orientation, this idea was opposed by the *comunidad* assembly, mainly due to fears of water pollution and of the village springs drying up if the water table lowered (interview with Miranda 2009).

Other observations related to village-scale orientation are not directly related to water, but reflect Taleans' continuing ambiguous attitude toward technology, and toward the state, in the post-1992-reform era. González (2001, 60-61) found that "many Taleanos expressed a fascination with 'modern' devices and technologies," and cited the example of a local "technological hero" who had "designed a wooden water mill for extracting the juice from sugarcane." Yet, "by [. . .] 1997, I had detected a certain disenchantment on the part of at least some villagers with the effects of these changes on everyday life." However, González "took these observations with a grain of salt – particularly since those critiquing technology were often the same people who most aggressively sought it."

The same ambiguity is directed toward government programs. González mentions complaints about a national anticholera campaign's chlorination of local drinking water (2001, 61), and that "even today various officials from the government and NGOs arrive with plans to improve coffee but are politely ignored by many campesinos" (2001, 221). I observed disappointment with the recent CONAFOR-initiated Payment for Environmental Services program (PES) (see sub-section 5.1.3).

These attitudes can be considered signs of enduring village culture. I encountered other examples of this. The *municipio* recently considered restricting the sale of goods from Oaxaca City, to help Talea's tradition Monday market, which features local products, to regain its former prominence. A new *colonia* (neighborhood) is being built near the old airstrip at the edge of the main settlement area. Although it is partly on an individual's parcel, the *núcleo* is apparently paying for the construction, and will recoup the investment by selling the homes, though it will not sell the land.

On the other hand, the village tradition of *tequio* continues to decline. It is now mainly restricted to non-professional tasks like clearing brush; semi-skilled work such as road repair contracted to experts (interview with Méndez 2009). One *comunero* lamented to me that "someday no one will do their *tequio*." Interestingly, the government has tried to prolong the tradition of *tequio*, through a program of "temporary employment" in which they pay the *núcleo* to pay residents for part of their *tequio* work – but surely the introduction of money removes much of its village solidarity function.

Finally, there is the introduction of the Internet to Talea. In 2009, Internet was still essentially a "community" activity: only a few, slow connections were available, in a "café" an in a small library. This situation is unlikely to last long, however, as more individualized connections become available. On the other hand, the Internet does afford opportunities to express village-scale pride, as a beautifully produced 2007 YouTube slide show demonstrates (http://www.youtube.com/watch?v=UEW5W7r8f9I, accessed April 29, 2009).

6.1.4 Sub-village-group water-related items in Talea

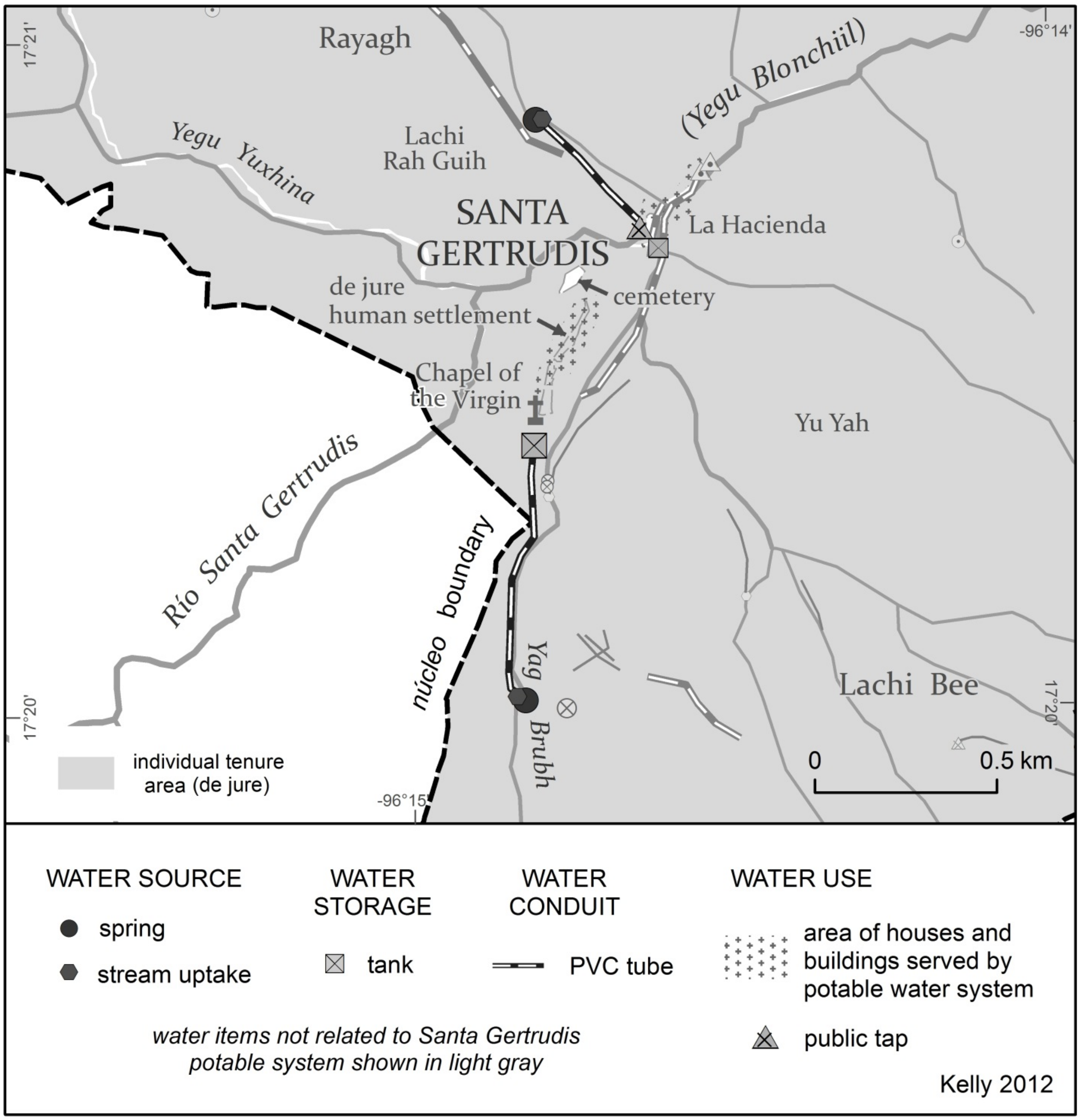
Water sources and infrastructure items tied to sub-village-scale groups fall into two categories: the potable domestic water supply for the hamlet of Santa Gertrudis (Figure 6.5), and the approximately half-dozen groups of residents which exploit specific water sources in shared irrigation schemes (Figure 6.6).

The potable supply for Santa Gertrudis (Figure 6.5) derives from two natural springs along perennial streams which have been modified into constructed water uptakes. Both uptakes are located on PROCEDE-certified individual parcels, and required an oral agreement between the *agencia* assembly of the hamlet and the parcel owners. One of the uptakes, near Lachi Rah Guih, is on the parcel of a woman who died in 2004, and had been "directed by the *comisariado* (*núcleo* authority) to give permission for its community use" (interview with Miranda 2009). Its location was chosen because it is about 150 meters upstream from the outlet of the existing wastewater pipe for the main population center, although I was told that "until they finish building the new treatment plant, the water from this uptake isn't as clean as it should be." The second uptake, south of the hamlet near the Yag Brubh stream, is on a parcel owned by an individual coffee farmer, who gave permission to the hamlet to build the infrastructure in 1998, including a metal pipe.

One of the two main holding tanks for Santa Gertrudis' potable water is in the *solar* (house lot) certified to the hamlet's assembly hall (grandly labeled "*palacio municipal*" on the PROCEDE map). Besides being distributed to homes, its water is accessible via a small public tap, beside a beautiful old stone bridge. The other tank, near the Chapel of the Virgin, is in the forested parcel of uncertain tenure status, mentioned in sub-section 6.1.2. A third (auxiliary) tank is in the right of way ("special area") polygon of Río Santa Gertrudis.

Clarke described irrigation in the Central Valley of Oaxaca (Figure 2.5, on page 56), a drier region than Talea's but flatter and more accessible to markets, as characterized by a "large number of small-scale and independent systems" (Clarke 2000, 96). Because the area has few large perennial streams to feed it, the valley's main river, the Río Atoyac/Salado, is not suitable for a valley-scale irrigation project, and so irrigation infrastructure is more typically at the scale

Figure 6.5: *Núcleo* of Talea, Oaxaca, in 2009 – Sub-village-group-scale infrastructure/ users, map 1 (potable water system for hamlet of Santa Gertrudis): Water-related items and land tenure areas (map shows part of Talea *núcleo* territory). Tenure types shown are de jure "individual" and "not individual." Together with map 2 (Figure 6.5), sample is about 60 percent of sub-village-group-scale items in Talea. (Sources: INEGI 2002b and participatory fieldwork).



of one to three villages. In Talea, the abundance of perennial water sources has resulted in a pattern of a few irrigation schemes (Figure 6.6) that are even smaller and more "independent" than those of the Central Valley. Because rainfall in Talea is, in most years, sufficient to maintain the principal crops (maize for subsistence, and coffee for market – though many coffee farmers do need additional water for coffee processing), these few irrigation groups exist mainly to cultivate crops which require more water than these crops do, such as roses (grown in a greenhouse), or to ensure more than one crop per year.

For their water sources, these sub-village irrigation groups usually draw from the *tomas* (stream uptakes) at or near natural springs. Occasionally, these groups draw instead from *pozos* – shallow, simple "wells" which expose subsurface water, usually without pumps.[85]

The longest PVC tube in the upper map in Figure 6.6, about 2 km in length, was installed in 1993-1994 by a *sociedad* of about eight owners of parcels above the stretch of the Santa Gertrudis river known as "Río del Rosario." The water is drawn from a stream uptake in a parcel owned by an individual not associated with the group. Before distribution to individual parcels, the water is stored in a sturdy tank at a prominent bend in the road to Santa Gertrudis. The second *sociedad* whose infrastructure appears in this map was organized in 1999, also with participation by the leader of the first group. Its *toma*, upstream from the first, has a similar storage tank, and also serves about eight landowners, some of whom cultivate *maguey* for distilled *mezcal*.

The lower-left map within Figure 6.6 shows the more modest infrastructure shared by another *sociedad.* This is the group that is extending the road to "La Cumbre," partly to revive maize and coffee agriculture in the area called "Atrás de la Cumbre" (unfortunately, I was told that the road's construction probably caused a nearby *pozo* to "dry up"). Farming in this terrain had

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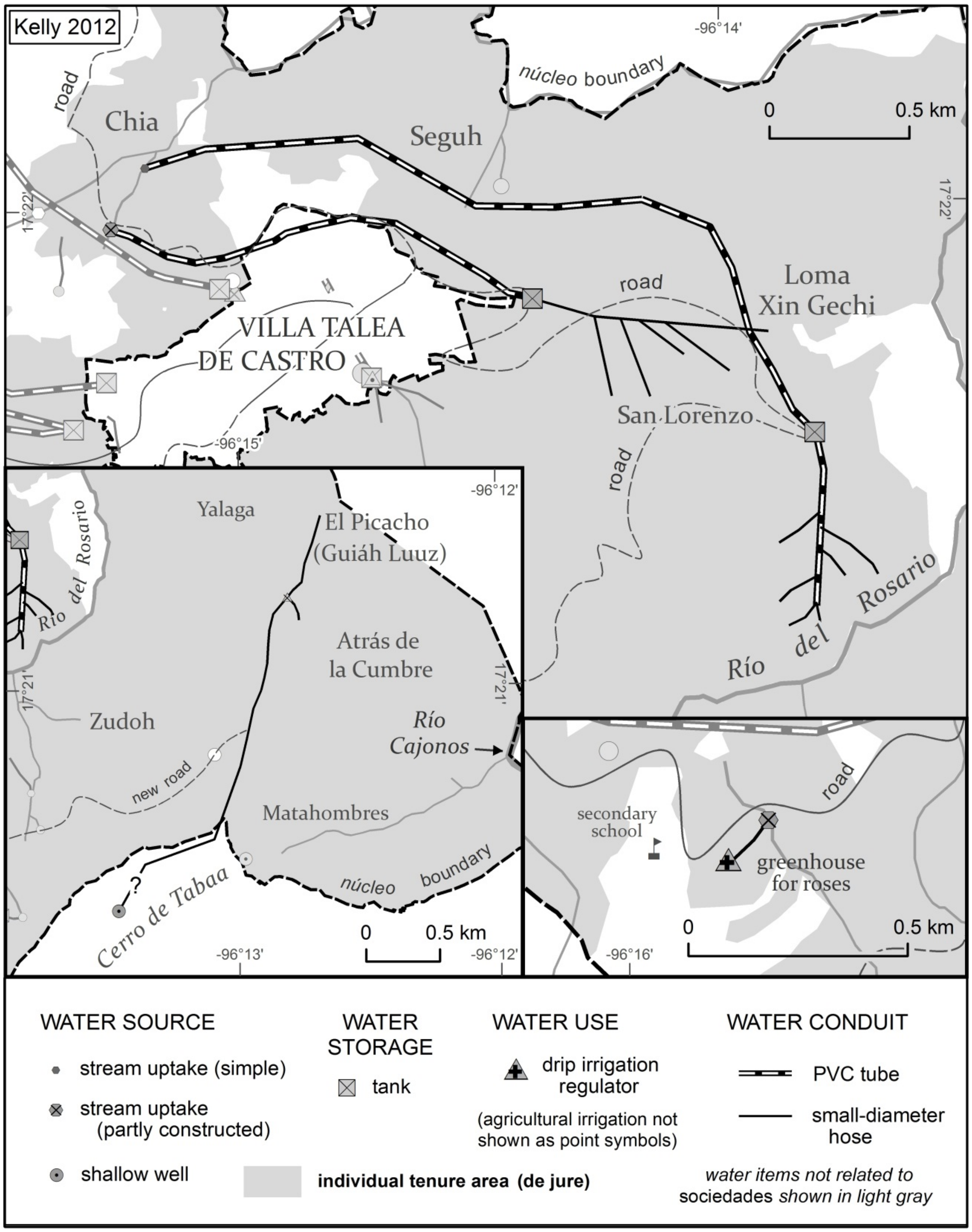
[85] These *pozos* resemble those described at the Preclassic-Classic Maya city of Dzibilchaltún: "Numerous 'wells' or small *cenotes* usually measuring less than a meter in diameter were found near ruin groups. The proximity of these to Pre-Hispanic architecture indicates that the Maya either dug or at least enlarged them. Masonry, often consisting of carefully dressed limestone blocks, is sometimes found at the mouth of these wells. The water table is 2 to 3 m below the surface" (Kurjack 1979, 6).

Figure 6.6: *Núcleo* of Talea, Oaxaca, in 2009 – Sub-village-group-scale infrastructure/ users, maps 2, 3, and 4 (various "*sociedades*": three for irrigating agricultural fields, one for irrigating a greenhouse): Water-related items and land tenure type (maps show parts of Talea *núcleo* territory). (Sources: INEGI 2002b and participatory fieldwork.)



been “abandoned due to introduction of chemical fertilizers (which doubles [maize] yield, so there is need to cultivate distant fields), and to outmigration” (González 2001, 41). The primary source for these farms is a spring in the Cerro de Tabaa area, most of which lies outside the present-day boundaries of the *núcleo*.

The lower-right map shows the water supply for a modern greenhouse, constructed by a group of Taleans on a PROCEDE-certified individual parcel. The roses are cultivated using a sophisticated drip irrigation system whose source of water is an uptake on a perennial stream at the edge of the same parcel.

6.1.5 Individual-scale water-related items in Talea

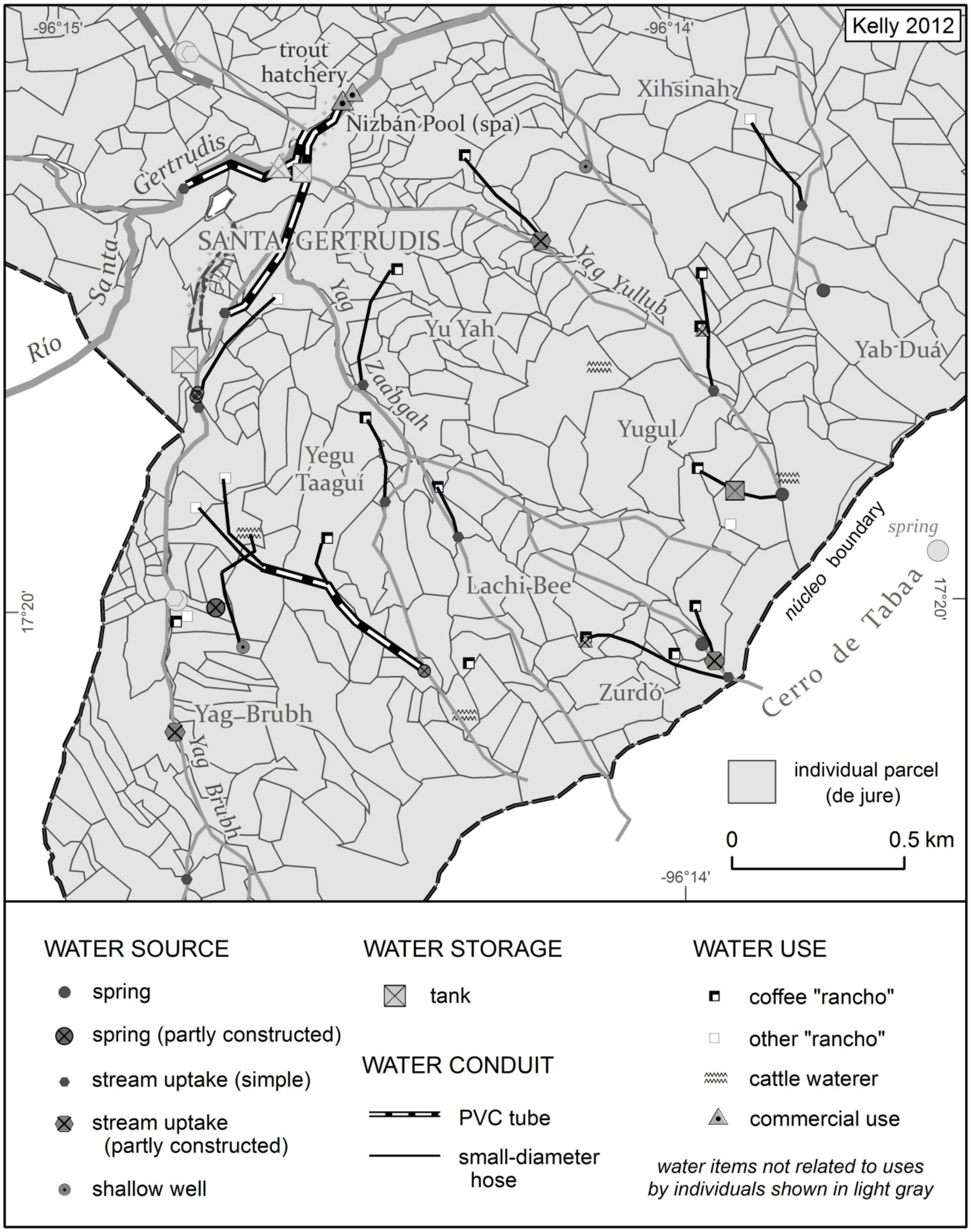
The map of individual-user water sources and infrastructure (Figure 6.7) includes most of the items in this category which I geolocated in the field. Several other individual-scale items beyond the boundaries of this map are visible in Figure 6.2 (on page 244). Figure 6.7 also displays the boundaries of individual PROCEDE-certified parcels. Most of the individual water items relate to the processing of coffee beans, some to the watering of cattle, and two have unique purposes.

During the participatory mapping meeting, I was told that only coffee beans on parcels relatively distant from the main population center require processing on site in “*ranchos*;” closer ones do their processing in town. Therefore, the greatest concentration of water-dependent coffee processing locations (Figure 6.8) is on the far slope, southeast of Santa Gertrudis.[86] Water is needed to wash the beans after they have been depulped, dried, and allowed to ferment for two or three days. González (2001, 206-207) observed that:

> Water is also a consideration when selecting a site. Cultivating coffee too far from a spring or waterhole is a bad idea, for relatively large quantities of water are necessary for ‘washing’ the coffee after its skin and pulp have been removed. The alternative is to ship the entire fruit back to the village [i.e., main population center] for depulping.

[86] In the Huasteca village of Chimalaco, all coffee cultivation occurs relatively close to the main village and highway. Thus, “the cafetales don't have *ranchos* – that is, they don't process beans in the parcels – so, they don't need much water” (interview with Salazar 2009).

Figure 6.7: *Núcleo* of Talea, Oaxaca, in 2009 – Individual-scale infrastructure/users: Water-related items and land tenure type (map shows part of Talea *núcleo* territory). De jure individual parcel boundaries are shown. Sample is about 25 percent of individual-scale items in Talea. (Sources: INEGI 2002b and participatory fieldwork).



He continued (2001, 215-216):

> The beans are transferred to a specially-made perforated tin (sometimes as large as a bathtub), and a water hose is dropped into the tank. A stirring paddle is used to loosen the remaining bits of pulp and other 'trash' from the coffee beans. The effluence drains away through the perforations, the beans are transferred gourdful by gourdful to a smaller 'tin' (a plastic tub with holes burned into the bottom of it with a heated nail), and then the process is repeated, using the arm and the hand instead of the stirring paddle.

Figure 6.8. Individual water use point on a parcel in Talea. The water is transported from a neighboring parcel, with that parcel owner's permission, via a flexible tube. The tray at right is used to wash coffee beans. (Photograph by the author in 2009).

Water must be transported from the source to the *rancho* structure, whether it is on the same individual's parcel or on a neighbor's. In the context of northern Mexico cattle ranching, Perramond calls these short-distance water transports "pseudo-irrigation strategies" (Perramond 2010, 67). I will review the transport of water from one parcel to another in sub-section 6.1.6.

The water uptakes are usually simple affairs. Often, a wooden, bamboo, or PVC length of half-tube focuses the streamwater, which also makes the site more useful for any thirsty person who walks by. A minority of uptakes are more elaborate constructions. A few have brick-and-cement, zinc-roofed storage tanks, built and maintained by the parcel's owner, even if he loans water to neighbors. Some uptakes are located at natural springs, springs modified with simple stone linings, or shallow "wells" (i.e., *pozos*, almost indistinguishable from modified springs); these often have metal screens covering the uptake point, to avoid clogging by leaf litter. At a hardware store in Talea in 2009, half-inch-diameter light-duty plastic hose cost 220 pesos (about twenty dollars) for 100 meters, while reinforced plastic hose cost 250 pesos. A join cost 3 pesos, and a 1½-inch T-connector cost 15 pesos.

Because they can be located with even more spatial flexibility than coffee *ranchos*, cattle waterers are usually placed directly at a water source; only in a few cases is the water transported a short distance by hose. In at least one case, a natural spring on an individual parcel was deepened and improved by the now-deceased owner. His widow "doesn't mind if anyone uses it, usually for animals which pass by," i.e., for *ganado suelto* (cattle temporarily allowed to roam free from parcel to parcel, or within the common use area) (interview with Toro Yescas, 2009). As with most of the *tomas* used primarily by individuals, this attitude of "anyone can use the water" makes it difficult to definitively assign these water uptake points as having "individual" users. For the purposes of this study, these water sources are considered as "individual," because that is their primary function, and because there is no shared responsibility for infrastructure maintenance. However, this permissive attitude toward fellow villagers must be kept in mind throughout the interpretation of the data.

The two individual, water-intensive use points with unique purposes are located at the edge of the Santa Gertrudis hamlet. There, a vigorous and prosperous Talean entrepreneur, developer of an impressive hotel in the main population center, in 2009 was building a trout hatchery and a recreational pool (*balneario*). Pisciculture has been promoted as a means of greater nutritional self-sufficiency in many *núcleos* in the highlands of Oaxaca, and in a few places it has generated thriving commercial enterprises or restaurants. In the case of Talea, I was informed that the trout farm was expected to only generate modest profits, but that it also served as a way for its owner to "give back" to his hometown, such as by being an important source of food during Holy Week, when many Talean expatriates come to visit. The water for one of the projects comes from an uptake within the right of way of the Río Santa Gertrudis, while the other gets its water from an uptake along a stream at the boundary of two private parcels. Both conduits are five-inch-diameter PVC tubes.

6.1.6 Talea: Analysis and summary

The tables in this sub-section summarize the relationships in Talea among the users of water (represented by points where water is extracted, stored, or used), and the ownership of the land (in Talea, both de fact and de jure) where those points are located. Water-related locations with multiple functions (e.g., "spring" and "storage tank") are counted, in these tables, once for each function. For the table entries which differentiate between water "sources" and other water-related items, "sources" refer to stream uptakes, natural springs, and *pozos* (modified springs or shallow wells). Water sources which were unproductive ("dried up") in 2009 are not counted, nor are the three items in the hamlet of Santa Gertrudis whose precise land tenure status I could not determine.

Table 6.1 gives the breakdown of water-related items on individual and community tenure areas among the three categories of user: individual users, sub-village groups, and the village as a whole. ("Users" almost always refers to whoever built, maintains, and benefits from the water-related infrastructure). Table 6.2 shows the same information, but considered from the opposite viewpoint: the breakdown of water-related items, for each of the three user types, among the two land tenure categories.

These tables show that the concordance between individual-user water items and individually-owned land is high, as is the concordance between community-user water items and community-owned land. The most noticeable mismatch is the 16 percent of water items on community territory which are for individual use (Table 6.1), but this is still a small percentage, especially considering that it represents only five percent of the individual-use water items overall (Table 6.2).

TABLE 6.1: All water-related items in Talea (n=87): For each de jure land tenure category (individual or communal), percentage of items in each infrastructure/use category.

	water item infrastructure/use		
	% individual	% sub-village group	% village
individual land tenure	82	16	1
community land tenure	16	11	74

TABLE 6.2: All water-related items in Talea (n=87): For each infrastructure/use category (individual, sub-village group, or village), percentage of items in each de jure land tenure category.

<table>
<tr><th></th><th></th><th>% individual land tenure</th><th>% community land tenure</th><th>(% not in núcleo)</th></tr>
<tr><td rowspan="3">water item infra-structure/ use</td><td>individual</td><td>95</td><td>5</td><td>0</td></tr>
<tr><td>sub-village group</td><td>79</td><td>14</td><td>7</td></tr>
<tr><td>village</td><td>7</td><td>93</td><td>0</td></tr>
</table>

The more interesting results concern the sub-village groups. From Table 6.2, we see that water-related items used by these groups are almost six times more likely to be located on individually owned land rather than on community land. This reflects the culture of Talea well: people form associations with specific purposes, but maintain clear individual ownership of agricultural parcels.

In Tables 6.3 and 6.4, I consider only the water *sources*, not other items such as storage tanks. This distinction is potentially important because water sources are generally more permanently tied to specific locations – and, therefore, to specific land tenure regimes – than other elements of water infrastructure. (Among the various kinds of water sources, springs are

TABLE 6.3: Water sources in Talea (n=42): For each de jure land tenure category (individual or communal), percentage of items in each infrastructure/use category.

	water item infrastructure/use		
	% individual	% sub-village group	% village
individual land tenure	76*	21**	3
community land tenure	43	0	57

TABLE 6.4: Water sources in Talea (n=42): For each infrastructure/use category (individual, sub-village group, or village), percentage of items in each de jure land tenure category.

		% individual land tenure	**% community land tenure**	(% not in *núcleo*)
water item infra-structure/ use	individual	90*	10	0
	sub-village group	88**	0	12
	village	20	80	0

*38 percent of the water sources in this category provide water to an individual *other than* the water source landowner.

**71 percent of the water sources in this category provide water to a group to which the water source landowner does *not* belong.

the most tied to specific locations, and wells are the least, with stream uptakes in between, although even wells depend spatially availability of groundwater).

When we include only sources, the concordances are rather weaker than before. This is not surprising, since, again, sources are relatively immobile; for example, it is easier to relocate a tank to a location with more precisely compatible land tenure, than it is to relocate a spring. The most notable mismatch is that only 57 percent of water sources on community land are used by the village as a whole (Table 6.3, while 43 percent of the community-tenure sources are used by individuals. However, this figure should be interpreted with caution: there were only seven community-tenure water sources included in the study, and so the “43 percent” of these used by individuals represents only three items: a spring 100 meters within the main common use area; the Lachi Lagunah spring, less than 20 meters within the main population center; and an uptake in the Río Santa Gertrudis right of way.

When only water *sources* are considered, the relationship between individual land tenure and sub-village water user groups is even stronger than before. All the water sources for these *sociedades* (and for Santa Gertrudis’ potable supply) are located on individual parcels, except for one which is not in the *núcleo* at all. 38 percent of the geolocated water sources on individual parcels have some of their water transported to other parcels with different owners (Table 6.4). At the participatory mapping workshop, I was told that the overall percentage is actually higher than this: “60 to 70 percent of us ask for water from our parcel neighbors.” Similarly, for 71 percent of the water sources which supply sub-village groups, the source landowner is not a member of the group.

For Table 6.5, I subdivided the community tenure areas into five sub-types, each subject to somewhat different legal strictures: 1. PROCEDE-certified common use areas; 2. the “donut hole” of Villa Talea de Castro, which is de jure common use by default; 3. parcels certified by PROCEDE to the *núcleo* for civic purposes; 4. *solares* in Santa Gertrudis certified by PROCEDE to the *núcleo* for civic purposes; and 5. “special areas” surveyed by PROCEDE as public rights of way.

TABLE 6.5: Talea, water-related items in different categories of "community land tenure" (n=19): Number of items in each infrastructure/use category. First number in a cell is total items; number in parentheses is water sources only.

	water item infrastructure/use		
	individual	sub-village group	village
common use area	1 (1)	-	7 (3)
localidad of Villa Talea de Castro	1 (1)	-	6 (1)
civic parcel	-	-	1 (0)
civic *solar*	-	1 (0)	-
special area (river)	1 (1)	1 (0)	-

A general observation is that all five community tenure sub-types include useful water items. A specific one is that Talea's unusual "donut" arrangement, which kept its main population center from being surveyed by PROCEDE, is the reason that six of the items (one of them a water source) are in a de jure common use tenure area. (If FANAR were eventually invited to survey and title the population center's *solares*, Taleans would still have the option of designating these water items as civic ones.)

I reiterate that the water sources geolocated by me and my Talean colleagues reflect human water use at least as much as they do "natural" water abundance. Clearly, the large, forested, PROCEDE-certified common use area is important for protecting most of the sources for the main population center's potable water system. However, the maps and tables in this section suggest that the array of water sources within individual parcels is at least as important, probably more so. Most of these water sources are used by individuals, often a different individual than the source's parcel owner. The definition of "useful water source," in other words, usually includes the idea that it be "in or very near a working farm."

It is perhaps surprising that none of the village-use items are located within the public watercourse rights of way ("special areas"), but the reason for this is straightforward: the few stream or river segments wide enough to be surveyed as rights of way are located at or near the bottom of the valley within the *núcleo*'s territory. Water within them, despite its abundance, is at too low an elevation to be useful for most activities, since nearly all water transport in Talea depends on gravity. Furthermore, water here is probably relatively unclean, being downstream from nearly all agricultural runoff (including cattle ranching) and point pollution sources within the *núcleo*.

The impression which arises from this web of land tenure and water practices is that of a community which expresses its cohesion, its village orientation, in several ways. One way is by maintaining a system of friendly permission, usually oral, to transfer water from one's individual parcel to another individual's parcel, or to an installation used by a sub-village group, or to the village as a whole. Nevertheless, the land tenure practice of distinct agricultural parcels owned by individual households persists. This particular blend of individual and community orientation – as well as skepticism toward the state, and cultural separation from, yet commercial ties to, the larger national system – recalls the practices of, for example, Amish communities in the United States (Kraybill 1989, 12; Robinson 1997).

I conclude this section with a few thoughts about bottled water. Despite their enviable blend of commercial savvy, village-scale pride, and plentiful, clean water, to date no Taleans to my knowledge have attempted to market locally bottled water. Perhaps their caution stems from observing the checkered recent history of bottled water ventures in the region. Small, simple commercial bottled water plants have been established in several villages in the Sierra Norte, whose water may become increasingly valued as droughts more frequently impact the Sierra Sur and deforestation continues to desiccate the Mixteca region. One example is in my Oaxaca geodata analysis area: the "Shoo Ra" cooperative bottling venture, in the *comunidad* of Yavesía, about halfway between Tlacolula and Ixtlán (Figure 2.4, on page 53). The project is run by a subset of *comuneros* (villagers), some of them living in the United States, with start-up funding from their remittances as well as a government grant. The water taken from a spring, purified, bottled, and transported to stores in Ixtlán, Oaxaca city, and a few other locations (Ayuntamiento de Santa María Yavesí 2008, 65).

However, the Yavesía effort has faced two problems typical of such ventures: First, to recoup start-up expenses, the water must be sold at too high a price to compete successfully with large companies, which get their water from wells in the densely populated Central Valley (Flores Mandragon 2007, 47). Talea, located yet further from the Central Valley, would fare even worse. Second, the venture has generated conflict[87] among the *"mancomunados"* (partially unified) villages, of which Yavesía is one, over whether forests should be conserved for water, or sustainably exploited for commercial wood (Flores Mandragon 2007, 48).

6.2 Tiltepec and Yagila: Land tenure and water sources in comunidades without PROCEDE parcels

In this section I discuss the relationships between land and water in two other Zapotec *núcleos* of Oaxaca state: Tiltepec and Yagila. Both are located 20 to 25 km northwest of Talea (see Figures 2.4, 2.5, and 2.6, on pages 53 to 59), though the distance by vehicular road, much of it unpaved, is at least 70 km.

The maps in this section are similar to the ones in the previous section for Talea, but without separate maps for each scales of users and infrastructure (village, sub-village group, or individual). The three scales can be inferred from the pattern of water transport conduits attached to some water source points, and they are differentiated in the tables. Because the features I geolocated in the field are spatially clustered, I have included additional larger-scale maps which display most of the features more legibly.

One difference between the maps in this section and the maps of Talea is that these maps depict de facto land tenure boundaries, not de jure ones, because neither Tiltepec nor Yagila had its internal areas of individual parcels (nor the parcels themselves) surveyed by PROCEDE. The boundaries between individual and common tenure areas are shown as fuzzy lines. This

[87] The conflict presents an interesting comparison to one in Shapleigh, Maine, United States, where local environmentalist opposition to the multinational corporation Nestlé's attempt to expand its wells for Poland Spring brand bottled water led to a new town ordinance banning "large-scale water extraction on town-owned land, state-owned land or privately owned land" (Todd 2009).

fuzziness mainly reflects the fact that I did not have enough fieldwork time to precisely and participatorily locate every vertex of every tenure zone. In some places, the fuzziness also signifies that the boundary is truly indefinite and indistinct in the minds of local residents. It also serves the additional purpose of removing any possibility that precisely located personal information could be extracted from these maps, as per the requests made by both communities.

Another difference between these maps and those for Talea is that, among water sources, “springs” feature more prominently in these *comunidades*, rather than “stream uptakes” downstream from springs. This is partly due to my having spent more time doing fieldwork in Talea, but it may also reflect an actual difference within the communities. It is possible that the greater emphasis of coffee production in Talea, and thus the greater number of “*ranchos*” which need water to process beans, has led Taleans to more often utilize nearby streams rather than more distant springs.

There are three sub-sections devoted to each of the two *comunidades.* The first is a brief introduction to the *núcleo* and its land tenure areas, and includes a map of the GPS points taken. In sub-section which follows, I present and describe the maps of water items and de facto land tenure areas. In the third sub-section, I interpret the tables generated by the data. Local informants are cited by name only if they were interviewed by me specifically for the present study.

6.2.1 Tiltepec: Introduction and land tenure areas

Legally, the *comunidad* of Tiltepec includes the entire territory depicted in Figure 6.10. However, approximately 35 percent of the area is controlled by the functionally separate village of La Luz (see Figure 6.9, on page 273), called an “annex” in the FANAR documents. Because the residents of La Luz did not participate in the fieldwork for this study, their de facto territory is not included in the analysis.

Even after subtracting La Luz, the *núcleo* of Tiltepec covers almost twice the land area of Talea, but with less than one third its population. It is also more isolated than Talea: the only road to Tiltepec is still unpaved, and is entirely impassable after landslides during some rainy seasons. Due to both its lower population density and its lesser commercial orientation than Talea, Tiltepec has a greater proportion of its land area covered in continuous-canopy, more-or-less "natural" forest. The altitudinal and precipitation ranges are comparable to Talea's (Figure 2.4, on page 53). As can be appreciated in Figure 2.5, Tiltepec does contain more extensive cloud forests than Talea (because of its location closer to the Gulf Coastal Plain), as well as more tropical rain forest (because of its somewhat lower average altitude than Talea's).

Among the RAN document study *núcleos*, Tiltepec shares with Tepetotula (Figure 2.5, on page 56) the distinction of probably having the greatest abundance of perennial, clean water sources. Even more than in Talea, only those water sources with at least some direct use to the village or to any of its residents were included in the participatory GPS fieldwork. Many other unnamed and unmapped springs are certainly located at or near the heads of the numerous streams which abound in the *núcleo* territory.

This abundance of forest and water was recently given some degree of recognition when the villagers declared two large parts of their territory to be "natural protected areas," specifically, in part, for the conservation of "water resources." However, it is not known how much of the *comunidad* assembly actively participated in this declaration; the boundaries of the reserves are approximate;[88] and the special land use or other behavior rules (locally written and codified, or otherwise) are apparently vague (for example, there are several agricultural "*ranchos*" within one of the reserves). These "reserves" were probably inspired by interaction between the *comunidad* authorities and the Mexican federal agencies of CONAGUA, CONAFOR, and perhaps SEMARNAT, although the zones are not part of any government's ANP (natural protected areas) system, at least not yet.[89]

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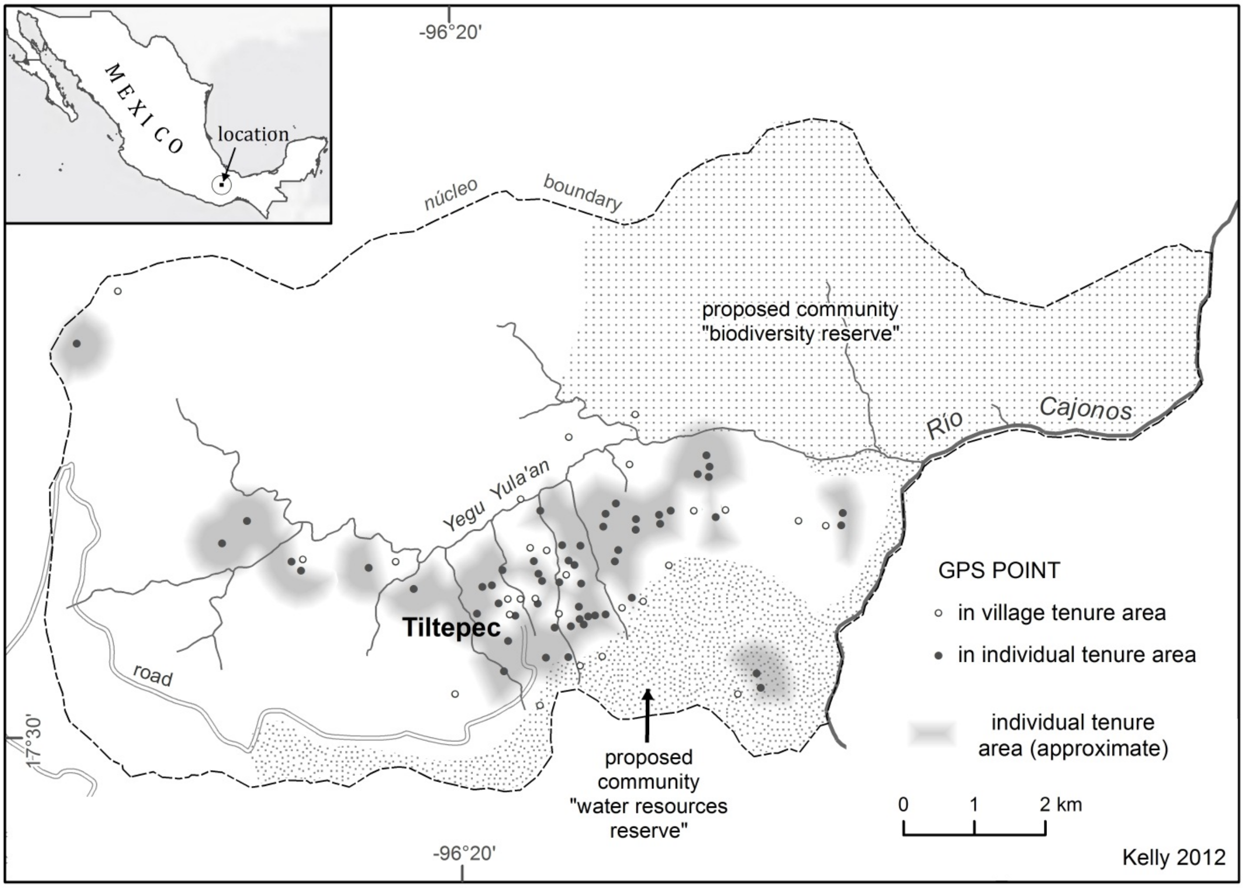
[88] According to the notes taken during the making of the sketch maps showing these reserves, the most precidely identified and agreed-upon boundary point is a prominent waterfall which marks the western boundary of the "biodiversity reserve."

[89] In their physical attributes and their water-protection emphasis, the zones resemble the five village-scale reserves established at similar mixed cloud/tropical humid forest forest patches of the Las Balsas watershed, in northern Costa Rica. Coordinated by an NGO called the Nectandra Institute, these reserves were located where specific important springs serve potable water systems (known in Costa Rica as Asociaciones Administradoras de Acueductos Comunales, or "ASADAs") for specific villages downslope. The springs and villages are linked by tubes, each between 1 and 8 km long. Unlike in Tiltepec, the land around each ASADA spring is owned by private individuals (Gentes 2010, 6). Parts of these parcels immediately surrounding the springs were

Figure 6.9. Tiltepec: De facto land tenure areas (approximate), including proposed village-scale natural protected areas, and locations of GPS points taken during fieldwork.



The "individual" and "community" tenure areas shown in Figures 6.7, 6.8, 6.9, and 6.10, while sometimes approximate in their location, are considered "real" by Tiltepec's residents. In 1981, two *comuneros* resolved a parcel boundary dispute by placing rocks along boundary (RAN 1981-86, 377). In the field in 2007 and 2008, while taking each GPS point (Figure 6.9), the local investigator was asked the nature of the tenure at that location, and on every occasion the reply was an unequivocal "*dueño*" (owner) or "*comunal*." The individual parcels range from about 0.4

purchased by the village from the private landowner, assisted by an "eco-loan" from the NGO. Each loan was then gradually repaid by community members, by doing reforestation work and other conservation activities; thus, the land purchase was essentially donor-driven, albeit with significant direct involvement by village beneficiaries (Herrera Rodríguez 2010).

to about 3 hectares each, and are used mainly to grow maize, raise cattle, or cultivate coffee, with secondary uses including sugar cane, fruit trees, and minimal timber exploitation.

Somewhat in the manner of the *núcleo* of Totomoxtla (see sub-section 5.3.2), another *comunidad* whose tenure areas have not been simplified by conforming to the PROCEDE mold, the zones of land use patterns in Tiltepec are loosely organized into concentric rings around the main population center. Interestingly, while the spatial patterns of human activity change markedly along this continuum, neither land tenure nor land use changes much. In other words, except for deep forest areas (which are communal by default), a similar mix of common use and individual activity areas exists close to the population center and far from it. Most *comuneros* own several parcels, typically four or five, usually "scattered among different elevational zones" (Brady 2008).

Closest to the population center is an area of more or less continuous parcels, although most of the parcels contain forest patches, fruit orchards, or coffee shade canopy trees. Not all parcel boundaries are physically marked; some simply have "known" locations. Common use parcels in this zone are usually designated thus due to some specific occurrence, such as an area which has poor soil (used for firewood and timber), or two others which were adjacent to the old population center half a kilometer north of the current site and have retained their common use status (used for maize and other plantings, with assembly permission).

Around this is a zone where true forest cover predominates, interspersed with some coffee plantations, cattle ranches, and maize. This zone is the source of most firewood, mostly secondary vegetation on owned parcels, cut by the owner to make a new clearing and gathered with his permission by other *comuneros* (Brady 2008). Once an individual invests significant effort in a parcel – for example, by maintaining permanent pasture cover for cattle – he is recognized as the permanent owner, and rights to it are transmitted by inheritance but cannot be sold. At the outer edges of this zone are several bean plantations which are collectively operated and, in two cases, communally "owned."

Beyond this, human activity is concentrated along four large paths which penetrate far into the surrounding forest. Here, most parcels are "*ranchos*." As in Talea, a *rancho* is a small, permanent structure where products grown on the surrounding parcel are processed and/or stored (usually sugar cane, but sometimes coffee or maize). Usually, one *rancho* serves two or three nearby parcels, often owned by close relatives. Individual parcels are acquired in this zone simply by a *comunero* clearing and planting an unused area; the *núcleo* assembly need not even be consulted, unless there is a dispute.

6.2.2 Water items in Tiltepec

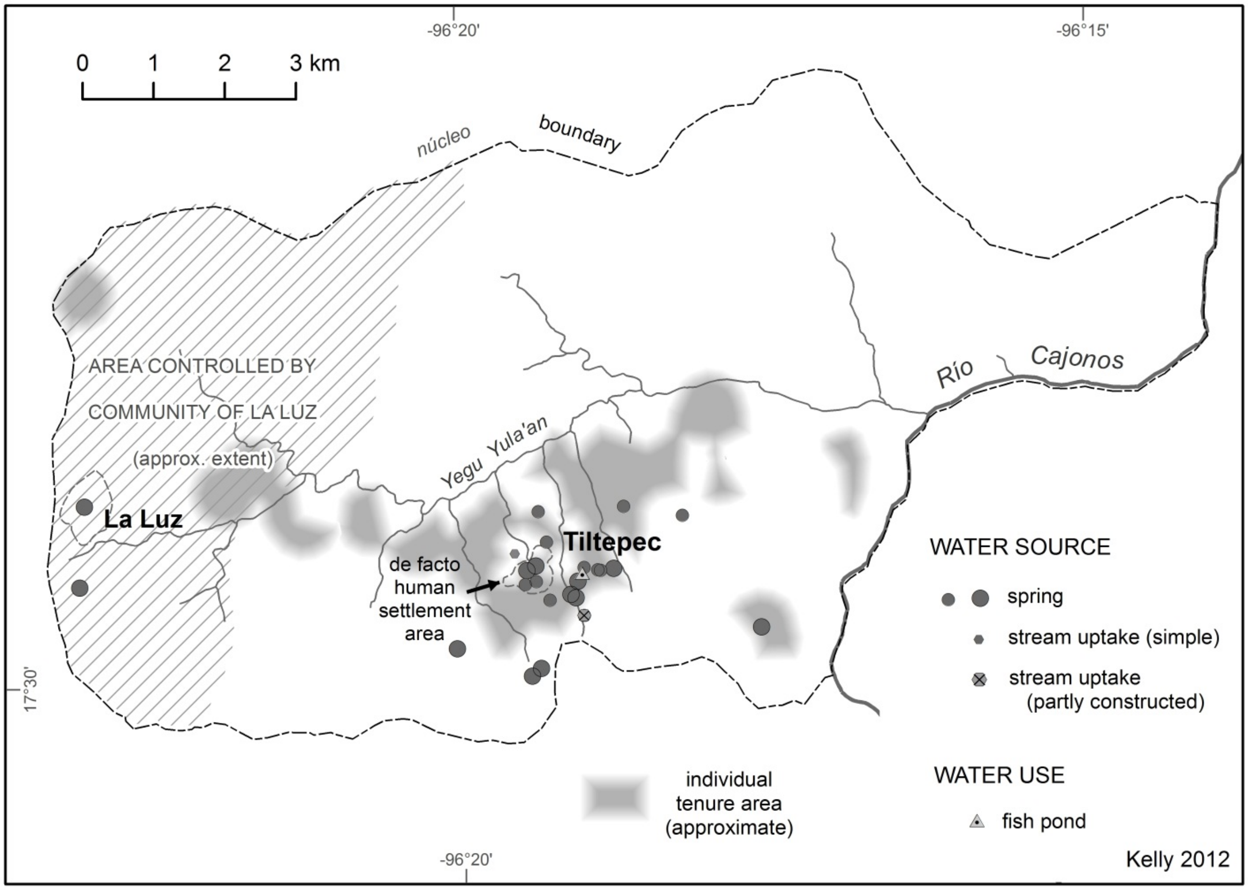
Tiltepec is unusual among *núcleos* in that its territory neatly occupies an entire watershed, that of the 9-km-long stream known most commonly as Yegu Yula'an.[90] This stream flows into the Río Cajonos, which marks the eastern boundary of the *núcleo*. The other boundaries follow the high rim-shaped ridgeline. Not surprisingly, uncertainties have historically arisen at both places where a boundary segment must be chosen to connect the ridgeline to the Río Cajonos.

Due to the high-rainfall climate, about 40 permanent streams feed the Yegu Yula'an in parallel courses (only a few of these are shown in Figure 6.10). Participatory mapping work during the México Indígena project revealed a remarkable toponym density of streams and stream segments; even in areas seldomly visited, streams have Zapotec names known to many residents. Figures 6.10, 6.11, and 6.12 show the location of some water sources deemed important by the community.

For the population center's domestic potable water supply, there is neither a single large system (as in Talea), nor a pair of "*barrio*-scale" larger systems complemented by smaller ones (as in Yagila, described below). Instead, all houses are supplied by small, shared potable water sources. These are groups of about five houses which share the use of a spring or stream uptake, typically about 500 m away. Some groups use a shared tube, while others share a source but use individual hoses. In Figure 6.11, conduits for just one of these smaller systems are shown as an example, one fed by a spring called Rui Gaa. In Tiltepec, two of the small shared systems are distinct from the others by the presence of a shared storage tank, making them almost "*barrio*-scale" systems. Classification of potable water systems is imprecise, because in rural Mexican

[90] During my fieldwork I came to realize that the Zapotec word "*yegu*" glosses as "stream," but only rarely refes to the entirety of a single watercourse. More precisely, it is a "place dominated by part of a watercourse." Thus, a stream may have several names, one for each stretch; and, conversely, a group of small tributaries may share the same name.

Figure 6.10. Water items and approximate de facto tenure areas in Tiltepec, Oaxaca – entire *núcleo*. (Sources: RAN 2008 and participatory fieldwork).



population centers there is a continuum of practices for domestic water, ranging from individual, single hose from an unshared nearby source, up to a village-operated system where everyone is served by a network originating from the same few, more distant sources. For the present analysis, I consider these sources to be used by "sub-village groups," because several *comuneros* usually (though not always) share the maintenance of infrastructure. For example, as observed by Scott Brady (2008), at one spring:

> The responsibility for maintaining the *manguera* [hose] east of [a *comunero*'s] house was the responsibility (*tequio*) of two members of his neighborhood. Thus the neighborhood's management appears to extend beyond the *zona urbana* [population center] limit to the *manantial* [spring] that provides it with water. Most of the *barrios*

> extend to the *zona urbana* limits. So, maybe the *manantiales* and *mangueras* that provide water to the individual *barrios* function as peri-urban regions of water management.

Compared to Talea, there is little formalized sub-village-group irrigation for the cultivation of commercial products. In Tiltepec, only one water source was identified with a sub-village user group beyond the small potable domestic supply systems: a spring used to water a beanfield cultivated commonly by a group of *comuneros*.

Figure 6.12 shows two examples of water conduits (in this case, 1.25-inch-diameter general service rubber hoses) used to irrigate individual parcels far from the population center. As in Talea, there are many instances of water taken from a stream or spring in one parcel and someone else's parcel. In Tiltepec water is sometimes transported to an individual parcel over a surprisingly long distance, such as the 1.5-km hose shown in Figure 6.12 which services a coffee farm. In this case, the water source is on de facto common use land. Similarly, the 500-m-long hose shown near the upper-left corner of Figure 27 is fed by a stream uptake in a communal forest patch close to the human settlement area. This conduit serves two individual parcels (a coffee farm and a cattle ranch), and its installation costs were shared by the two owners.

Three springs were identified within the "protected area for (partly) water conservation." All three are used "communally," although only one of them is used for an active, village-wide purpose – occasional irrigation for a shared beanfield nearby. The other two springs are "communal" simply because they are not used by any specific individual, but they are near paths where many *comuneros* pass (one is on the route to the village of Josaa, the other on the route to the eastern *ranchos*). They occasionally provide refreshment for any individual, and the occasional beast of burden. If a full-scale potable water system were installed someday for the village, one or more of these springs would likely serve as its sources.

Figure 6.11. Water items and approximate de facto tenure areas in Tiltepec, Oaxaca – detail of main population center and nearby agricultural and forest areas. (Source: participatory fieldwork).

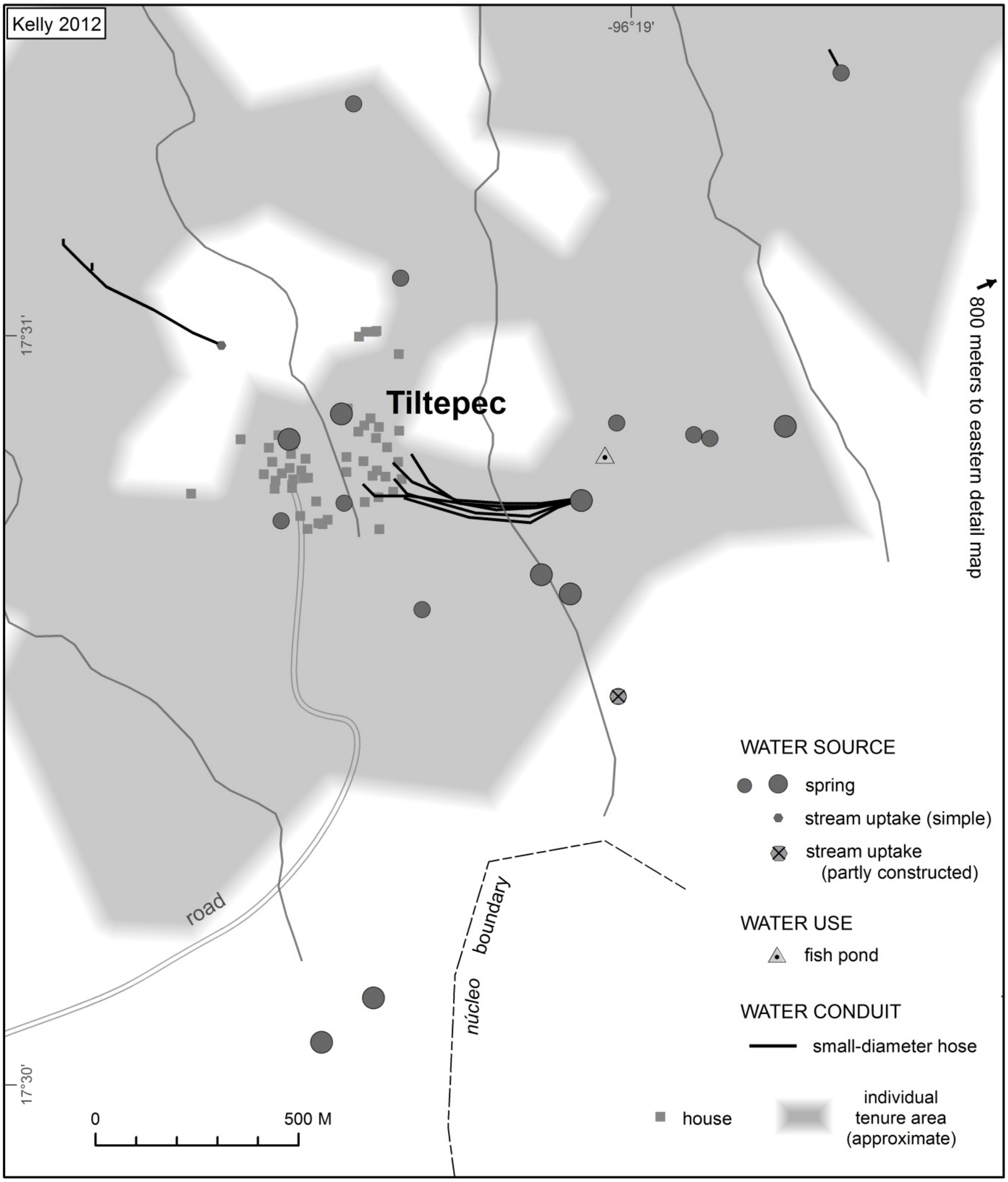
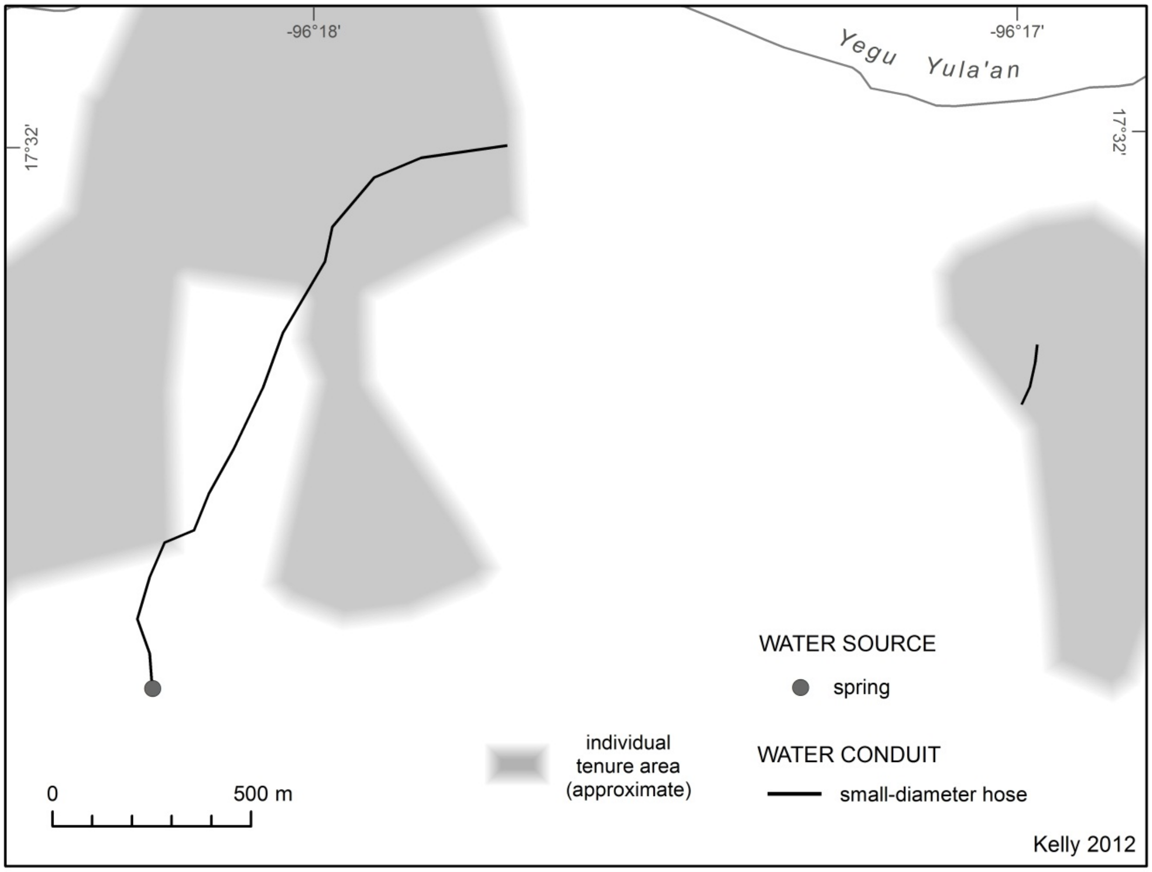


Figure 6.12. Water items and approximate de facto tenure areas in Tiltepec, Oaxaca – detail of a sample agricultural and forest area. (Source: participatory fieldwork).



6.2.3 Tiltepec: Analysis and summary

Tables 6.6 and 6.7 show the relationships among water source users (village, sub-village group, or individual) and the de facto land tenure where the sources are located. They can be compared to Tables 6.3 and 6.4 for Talea, on page 266. One should bear in mind that, on some conceptual level, all water sources are "communal," independent of who actually uses them, or whether they are located on an individual parcel or a common use tenure area. For example, a *comunero* explained that "the Ruu Gaa spring[91] is communal in terms of who has rights to the water, but it is in a parcel with an owner. No one fights over water, although in the driest part of the dry season, it is distributed with more care." Today this spring is used neither by the village as a whole, nor exclusively by the owner of the parcel around it, but rather by several individual houses in the human settlement.

However, on another conceptual level, specific water rights are indeed "real." This is revealed when a complaint or conflict arises, which occasionally does occur, as documented in my RAN archival research and Laura Nader's work in Talea. In well-watered regions, only rarely do conflicts arise because too much of the water itself is depleted by an individual. When intra-village water-related arguments do occur, they usually concern some infrastructure which into which an individual has invested effort and capital. For this reason, in Tiltepec, Yagila, and Talea, local informants sometimes explicitly clarified to me that a particular water source was available for use by "anyone that wants to," even though some individual had installed infrastructure there and was its principal user. Four of the Tiltepec individual-use water items (31 percent of the total) were so described; of these four, three were located on individual-tenure parcels.

Two of the "village use" items are springs in the main population center, used mainly for domestic potable water. Like the Tres Chorros spring in Talea, they are a vestige of the time when all domestic water was hand-carried from a spring or pumped well in the heart of the population center. Like the Lachi Lagunah spring in Talea, they serve multiple purposes today, including as a social clothes-washing spot. Both of these springs are in ambiguous tenure areas. They are close enough to houses that, were FANAR to survey Tiltepec's *solares*, they would probably be included in individual *solares*; thus, I considered the land around them to have de facto individual tenure status.[92]

[91] This spring has special significance because water was once carried from it, by hand, to the old village site. Scott Brady observed that the *camino real* (principal footpath) connecting the spring to the old village "functioned in the manner that the mangueras [tubes] function presently" (Brady 2008).

[92] Direct evidence for the individual orientation toward house lots in Tiltepec comes from a dispute in the 1980s, documented by complaints and legal replies filed in the RAN archives. One *comunero* accused another of letting his animals invade his territory, and also disputed the bounary line between their *solares*. The

TABLE 6.6: All water-related items geolocated in Tiltepec (n=23; all except 1 are water sources): For each de facto land tenure category (individual or community), percentage of items in each infrastructure/use category.

	water item infrastructure/use		
	% individual	% sub-village group	% village
individual land tenure	65	18	18
community land tenure	33	17	50

TABLE 6.7: All water-related items geolocated in Tiltepec (n=23; all except 1 are water sources): For each infrastructure/use category (individual, sub-village group, or village), percentage of items in each de jure land tenure category.

		% individual land tenure	**% community land tenure**
water item infra-structure/ use	individual	85*	15
	sub-village group	75	25
	village	50	50

*46 percent of the water sources in this category provide water to an individual other than the water source landowner.

A comparison of Table 6.3 with Table 6.6 suggests that the congruence between land tenure and water users is broadly similar in Tiltepec and Talea, although slightly lower in Tiltepec: 18 percent of its village-use water sources are on de facto individual property, while only 3 percent of Talea's village-use water sources are on de jure individual property. When the

accused replied, about the *solar*, "I consider it my property, since I've worked it for ten years; and [my accuser] as well as all the other citizens know perfectly well where the boundaries lie" (RAN 1981-86, 376).

same data is considered instead by distributing each use category among the tenure categories (Tables 6.4 and 6.7), the difference in congruence between Talea and Tiltepec is somewhat more apparent. In Talea, the congruence is still high. In Tiltepec it is rather lower, because water sources used by the village are distributed more evenly between individual and common tenure areas.

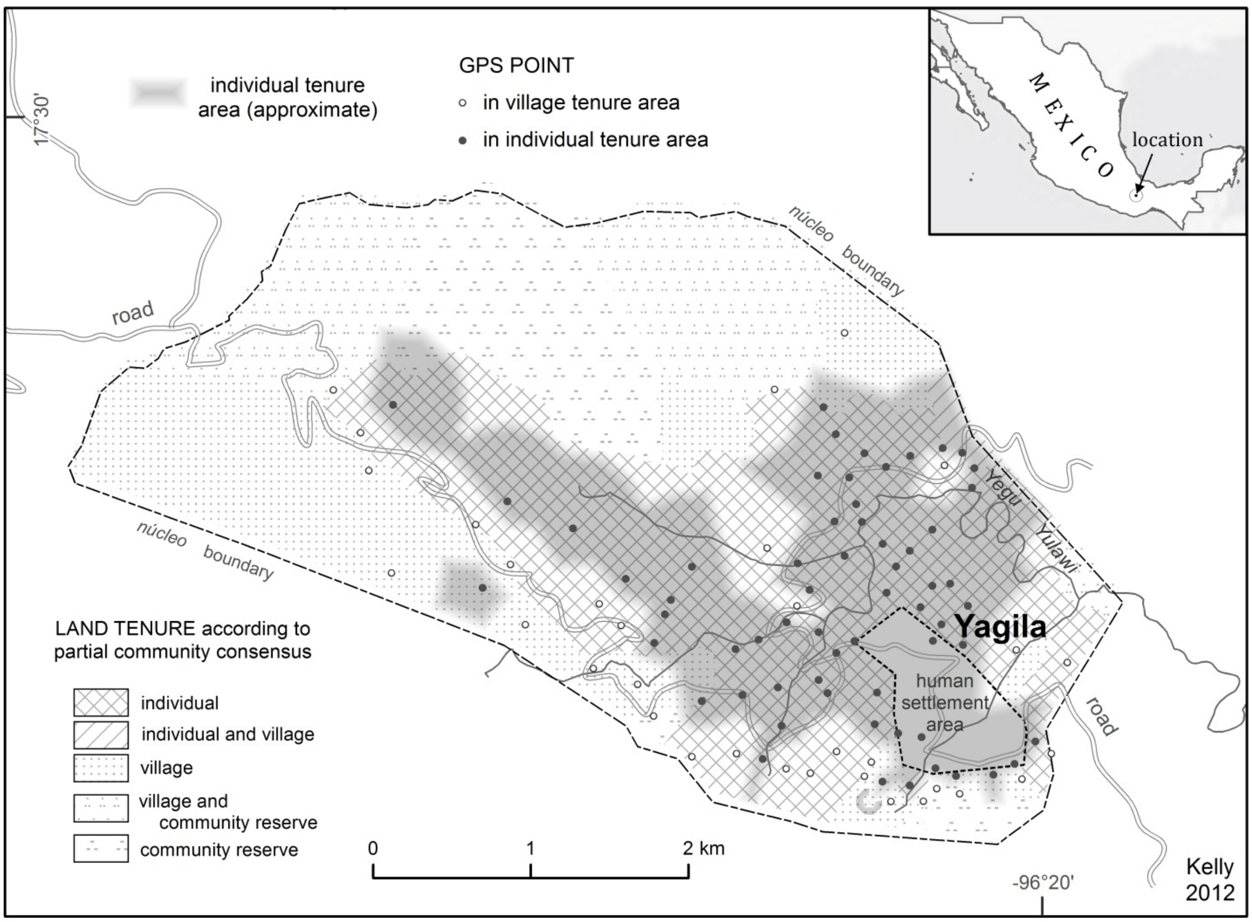
6.2.4 Yagila: Introduction and land tenure areas

Like Tiltepec, Yagila chose not to have PROCEDE survey and certify its individual parcels. However, in certain respects Yagila resembles Talea more than it does Tiltepec. Yagila (location shown in Figure 2.4, on page 53) is closer in size to Talea, in both area and population, than Tiltepec, and therefore its proportion of intense human activity areas to other areas resembles that of Talea. Additionally, its ecological situation somewhat more closely mirrors that of Talea, particularly in its preponderance of pine-dominated forest. Yagila's degree of isolation from paved highways and lowland or central valley cities is similar to Tiltepec's, although the 2009 completion of the unpaved ring road through the entire Rincón de Ixtlán has brought it a bit more within the national ambit, and it has a deeper tradition than Tiltepec of emigration to, and remittances from, emigrant destinations such as the United States.

The map of individual and communal de facto land tenure in Yagila (Figure 6.13) was developed from two sources: a map of *parajes* (named places) created by a *comunero*, assisted by other ones, during the México Indígena project; and, GPS points taken during PRM fieldwork, during which my México Indígena colleagues and I were informed of the land tenure status of each point by a local investigator. Each *paraje* was assigned communal, individual, or mixed status in a participatory meeting; in Figure 6.13, I refer to this data source as a "partial community consensus."

As in Tiltepec, the common use and individual tenure areas are often spatially well defined. On several occasions, while walking on a trail, a local informant indicated the precise boundary between the tenure types. Several community/individual tenure boundaries, including a 200 m line between Yeaj Beej and Yaba springs (Figure 6.15), are marked by row of a particular species of planted tree: *Heliocarpus appendiculatus* (in the Malvaceae family, formerly Tiliaceae), known locally as "*majagua*" in Spanish and "*yupusustu*" in Yagila Zapotec.[93]

Figure 6.13. Yagila: De facto land tenure areas (approximate), including areas defined during participatory mapping meetings, and locations of GPS points taken during fieldwork.



In Yagila, the concentric rings of land tenure are more homogeneous than in Tiltepec. That is, in Yagila, there and few individually held lands in the outer areas (except, as in Tiltepec,

[93] The tree is also known in general Sierra Norte Zapotec as "*yaga schquídi*," and is also sometimes called "*tzompantli,*" a word borrowed from Nahuatl (Bolaños Méndez and González 2008, 39).

near the main paths).[94] As in Tiltepec, however, the specific mix of land *uses* does not change much as one moves further from the population center: shaded coffee and maize dominate, with sugar cane and cattle ranching common as well, and some planted fruit trees.

A notable difference with Tiltepec is Yagila's deeper involvement in commercial forestry, mainly in communal tenure areas, which include pine reforestation and CONAGUA/CONAFOR-inspired forest "reserves." According to one informant, "the difference between 'communal' and 'reserve' lands is that any *comunero*, with the *comisariado's* permission, temporarily establish a *milpa* (maize field) in the communal land, whereas a reserve is known to be a bad place for agriculture, either because of its poor soil or because it is so far from the [population center]" (interview with Ramos Francisco 2009). The "temporary individual maize fields in common land" are concentrated just south of the main road connecting Yagila to Tiltepec and Ixtlán (in the western half of the *comunidad*). The rotation time for secondary vegetation can be more than 15 years.

In a 1-km-wide strip north of the road, the land in this western half of the *comunidad* is individually owned. The difference was made very clear to me when I returned briefly to Yagila in 2009 after a six month absence, and found the hills north of the road had been clear cut for "private [i.e., individual] agriculture" (interview with Ramos Francisco 2009). Reserve land is concentrated along the upper slope of the ridgeline marking the *núcleo*'s southern boundary. One informant attested that some reserve areas have individual owners, yet they are not authorized to cultivate there, only to extract commercial wood. The same *comunero* claimed that water conservation was one motivation for maintaining these rather small forest reserves. Indeed, the reserves are located near, but not exactly at, the two springs and water uptakes which feed the large-scale potable water supply.

De facto common use parcels include two belonging to schools. In one case, the former individual owner was compensated with a similarly-sized piece of land.

---

[94] Yagila has a long tradition of precisely-defined individual properties among its residents. In an 1801 "proclamation of gifts of real property" transcribed by the México Indígena team, a Yagilan itemized three houses (plus a foundation), two *solares*, and eleven "*tierras*" (one of these in Zoogochi, a nearby village). Of these, one house, the foundation, one *solar*, and five of the *tierras* had been sold to him; he included the name of each seller and the cost. Most of the "*tierras*" were identified by the name of their *paraje*, though word "*paraje*" was not used (de la Cruz 1801).

Article 76 in Section 2 of the boilerplate (i.e., government-template-based) *comunidad* statute states that "each *comunero* is obliged to delimit his parcels by drawing up [*levantando*] *Actas de Conformidad* with his neighbors" (RAN 2001b). However, a local informant asserted that "to acquire a terrain, whether it is purchase or inherited, the agreement [*trato*] is just by word; but, if one desires, one can request a stamped document from the *comisariado*, in which the rights of the acquired lands are granted – but only if the person wishes to do it this way." This suggests that the statute is not well integrated into the actual practice of the community.

6.2.5 Water items in Yagila

Yagila's hydro-topographic situation has commonalities with both Tiltepec's and Talea's. Like Tiltepec, its territory essentially covers a complete and self-contained watershed, that of the Yegu Yulawi stream, which after exiting the *núcleo* joins the Río Juquila near its junction with the Río Cajonos. Somewhat as in Talea, there are several long ridges which divide the territory into long, nearly parallel valleys, and the entire *comunidad* can only be seen from a few of the highest points. Water sources are generally plentiful (Figure 6.14), including a rich concentration of springs within 1 km of the human settlement area.

About 60 percent of the homes in the population center receive potable water from either of two installations, built with the assistance of CONAGUA funding and engineers and similar to Talea's system. The infrastructure includes 1.1-km-long pipes which begin at two permanent springs improved with collection tanks, labeled Xhebeyu'u and Xhubëshidzu in Figure 6.15. The pipes carry water to two storage tanks at the edge of the settlement area, a metal one built in the late 1980s,[95] the other a PVC tube built in the late 1990s. For these storage tanks, a written *acta* (contract) formalized the community's acquisition of its small footprint of land from the individual parcel owner[96] (interview with Ramos Francisco 2009). Together these two systems

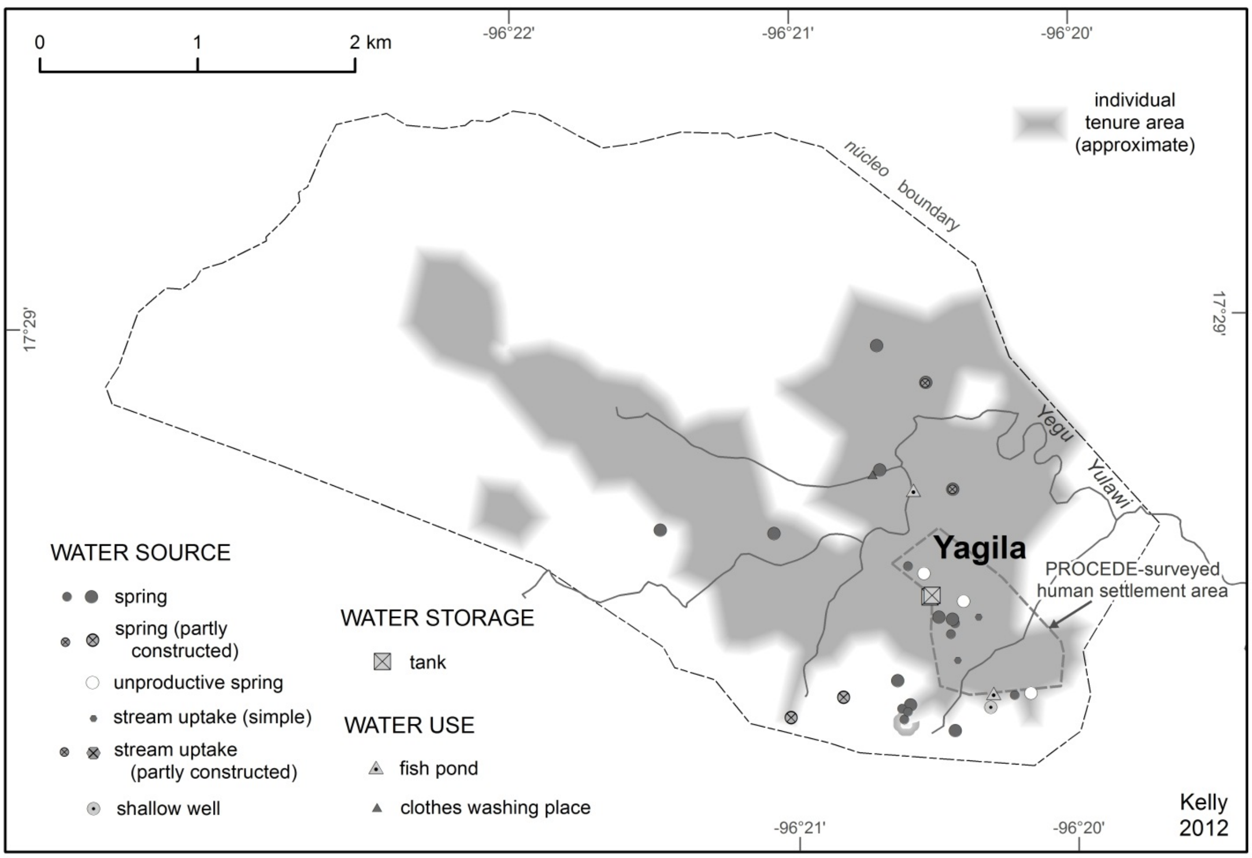
[95] A 1979 document in the RAN archives describes Yagila as having "no public services, but it is just starting to install a potable water network. There is no irrigation" (RAN 1979a, 133).

[96] In the PROCEDE-parceled Huasteca *ejido* of Santa Cruz, a similar arrangement is in effect. There, a "clear water" spring in an individual *ejidatario*'s parcel has been used by the community since 1993, when they installed a tube connecting it to the human settlement area. Unlike in Yagila, this was done without any formal written agreement (interview with López 2009).

serve all the homes in one of the three "*barrios*" (neighborhoods in the population center), as well as a few homes in a second *barrio*.

A third relatively large system, but smaller than the two just described, carries water 500 m from a spring just inside the settlement area and distributes it to most of the homes in a second *barrio* (that is, about 25 percent of all the houses). It has no holding tank as this would "cause

Figure 6.14. Water items and approximate de facto tenure areas in Yagila, Oaxaca – entire *núcleo*. (Sources: INEGI 2001b and participatory fieldwork).



too much pressure." Like the two largest systems in Tiltepec, this system is only slightly larger than a typical sub-village-use "small shared potable water source." All three systems are maintained by *barrio*-scale committees and owned by the community. A third tank at a spring called Los Sabinos once served as a bathing place and to collect water for some houses, but was abandoned when the spring "dried up about ten years ago – no one is sure why, but no one really noticed or cared, since there is so much water around" (interview with Ramos Francisco 2009).

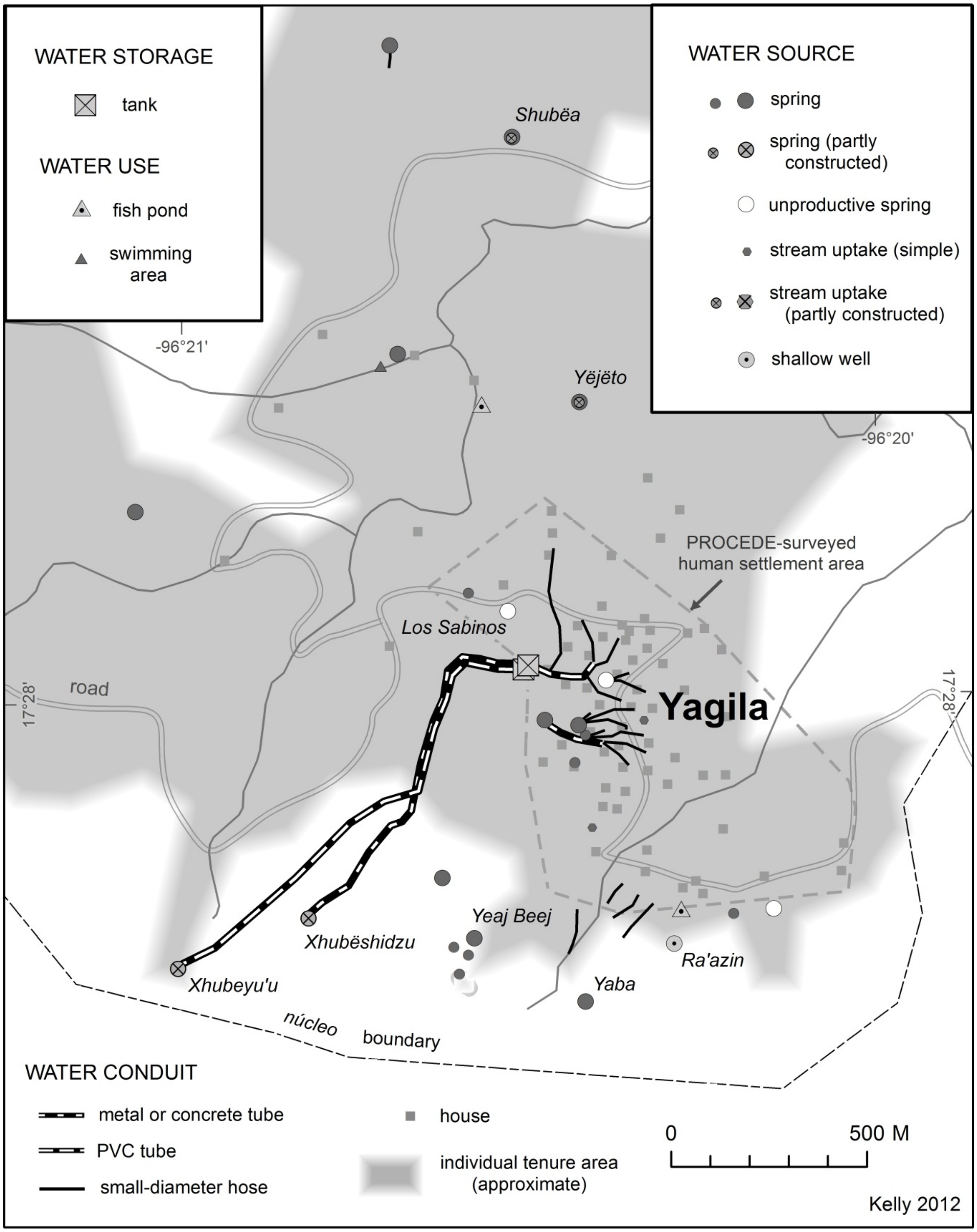
The remaining approximately 15 percent of the houses are served by typical small shared potable water sources, with each house linked by an individual hose to a nearby spring or stream uptake. One of these springs now nearly fails to produce any water. As in other *núcleos*, the introduction of potable water systems (even if incompletely) has led to the partial abandonment of water access locations within the settlement area. At least one pool along a stream is still sometimes used for washing and bathing. Beyond the settlement area, there is one notable water access point which is used by the entire community: a *poza* (natural pool along a stream), used for swimming especially during Holy Week, when extended family members living elsewhere visit Yagila. At a place called Ra'azin are two other water items with multiple users: a cement-lined spring in a communal pasture which provides water to a dormitory for secondary-school students, and a tank for edible fish under construction as a school project.

The group of springs at Yeaj Beej is near the boundary between an individual parcel used for cattle ranching and a common pasture. Trees are maintained around the springs, which are used mainly for watering cattle; there are no conduits issuing from them.

North of the population center, several springs are scattered among the many individually-owned parcels dominated by coffee groves. As in parts of Talea and Tiltepec, coffee is washed in *ranchos*, in many cases supplied by a neighboring parcel owner's water source. At Yëjëto, a spring is used for watering animals ("*abrevedero*"), and a PVC tube provides water access for humans. Not far from this is another tank for raising trout. Not currently in use, the tank was built by the community in an individual's parcel, and was maintained by a sub-village group.

At Shubëa, a seasonally productive spring along the main path "has no owner," though it is on an individual's parcel. The hollowed trunk of a tree called "*yarec*" (species unknown to me) directs water for use by passersby. Local residents informed me that these natural streams of water, lightly modified to facilitate human access, are known here as *chorros* in Spanish, and *bëdua* in Zapotec.

Figure 6.15. Water items and approximate de facto tenure areas in Yagila, Oaxaca – detail of main population center and nearby agricultural and forest areas. (Sources: INEGI 2001b and participatory fieldwork).



As in Tiltepec, many water sources are scattered throughout the higher, more forested lands furthest from the population center, but these are only used rarely by humans, notably to water cattle (interview with Ramos Francisco 2009).

The boilerplate *comunidad* statute (RAN 2001b) includes several references to the village-scale and individual use of natural resources, including of water. Three of the six rotating authority positions, those of the *Consejo de Vigilancia* (security council), must “permanently keep watch over the rational use of natural resources, principally water, stones, gravel, sand, and fruits produced to benefit the community, avoiding their destruction or loss,” along with five other duties. Indeed, all *comuneros* are required to “permanently keep watch over the resources of the community, and inform the assembly or the authorities of any irregularities or violations observed” (Section 3). Section 4 gives further details about natural resources:

> Article 54 – The community of San Juan Yagila is the unique and owner of all resources located within its territory, such as: stones, sand, fertilizer, ornamental and medicinal plants, as well as wild animals.
>
> Article 55 – Economic resources obtained through improvement/use (*aprovechamiento*) of natural resources will be applied to social service works previously agreed upon by the assembly.
>
> Article 57 – The springs and natural founts (*ojos de agua*) included within the communal lands will be for common use.
>
> Article 61 – Any *comunero* wishing to use a natural resource such as sand, stone, gravel, or wood must ask for permission from the *Comisariado* and inform the assembly.

Article 57 is especially germane to the present study. When this phrase appears in the statutes for *núcleos* who have PROCEDE-surveyed parcels but also some common use areas, its meaning is relatively clear: water sources in de facto individual-use plots, but within the de jure common use area, can be used freely by any *ejidatario* or *comunero*. However, when the phrase appears in *núcleos* such as Yagila whose entire territory is de jure “common use,” its meaning is ambiguous. It might refer to the entire territory, or it might refer to de facto (i.e., village-defined) “communal lands.” The mere existence of this ambiguity implies that the boilerplate text was prepared with a “standard” PROCEDE *núcleo* in mind, i.e., one with legally defined parceled areas *and* common use areas – despite the inclusion of Section 2 (quoted in the previous sub-section above), which is clearly designed only for *núcleos* without PROCEDE-surveyed parcels.

Another article (RAN 2001b) again reveals that the text was composed with a certain prototype in mind, in this case that of a rainfall-poor *ejido* or *comunidad* with widespread irrigation necessitating a community "irrigation unit" to apportion the right to scarce water. None of this applies to Yagila:

> "Article 90 – The use and exploitation of communal waters will be governed by the *Reglamento de Operación, Mantenamiento, y Conservación de Unidades de Riego* for rural development; its functioning will be coordinated by the *Directiva de la Asociación* of the users of the irrigation unit for rural development, composed of a President, Secretary, Treasurer, and two voting members [. . .] "

6.2.6 Yagila: Analysis and summary

Tables 6.8 and 6.9, like the previous tables for Talea and Tiltepec, describe the relationships among Yagila's water source users and the land tenure (in this case, de facto) where the sources are located.

According to interview notes collected by México Indígena student researcher Estrella García, the "permission between parcel owners to use a common water source [*yacimiento de agua*] is a form of reciprocity we call *guelaguetza.*"[97] This practice is approximately as common in Yagila as it is in Talea and Tiltepec.

True to Article 57 of its *comunidad* statute, the rate of individual use of water sources in or originating from common use tenure areas is markedly lower in Yagila (11 percent) than in Tiltepec (33 percent) or Talea (43 percent). Conversely, the community use of individual-tenure water sources is higher in Yagila (50 percent) than in either Tiltepec (18 percent) or Talea (3 percent). Even after taking into account possible differences in data collection priorities among the local investigators, this observation likely represents a real finding.

[97] While more popularly associated with large annual gatherings for exchange among ethnolingustic groups, the multiscale nature of the term *guelaguetza* in Oaxacan indigenous culture was noted by anthropologist Jefferey Cohen (1999, 87).

40 percent of the "village use" items overall are for potable domestic water, but only one of them (14 percent) is definitely in a communal tenure area. The rest of the "village use" water points are mainly for cattle watering, where there is often little distinction between them and water sources which are in fact used by one or two individuals, but anyone *can* use them.

TABLE 6.8: All water-related items geolocated in Yagila (n=30; all except 6 are water sources): For each de facto land tenure category (individual or community), percentage of items in each infrastructure/use category.

	water item infrastructure/use		
	% individual	% sub-village group	% village
individual land tenure	43	7	50
community land tenure	11	11	78

TABLE 6.9: All water-related items geolocated in Yagila (n=30; all except 6 are water sources): For each infrastructure/use category (individual, sub-village group, or village), percentage of items in each de jure land tenure category.

		% individual land tenure	**% community land tenure**
water item infra-structure/ use	individual	90*	10
	sub-village group	60	40
	village	60	40

*30 percent of the water sources in this category provide water to an individual other than the water source landowner.

Overall, congruence between land tenure and water users in Yagila is rather lower than in either Tiltepec or Talea. The most notable difference is with Talea, where 76 percent of the individual-tenure water items mapped were used by individuals, compared to 43 percent of Yagila's. While this figure does probably reflect a difference in the fieldwork methods, it does underscore the importance of tacit, oral, and written agreements among Yagilans.

To my knowledge, Yagila (like Tiltepec) has almost no sub-village groups sharing irrigation, something which is relatively common in Talea.

In some ways, Yagila represents an intermediate step between Tiltepec and Talea in the formalizing of rights to land and natural resources. For example, Yagila posseses a boilerplate *comunidad* statute and a PROCEDE-surveyed human settlement area, albeit without titled *solares*. Yagila is also between Tiltepec and Talea in its level of formal ties to government agencies: it has, for example, agreements with CONAFOR for forest reserves, and with CONAGUA for assistance with its potable water system.

Disputes in Yagila could potentially arise if the "mismatches" between land tenure and water source use, currently managed through intricate and locally understood practices, are exacerbated through their further formalization within the simplified, standardized, neoliberalized legal code. It would likely take many generations of out-migration and indigenous cultural decline before these local practices and oral agreements were so completely forgotten that the neoliberal dream of *reduced* conflict through a state-standardized, individual-oriented framework were to have any possibility of arising.

6.3 Summary of results

Based on detailed data from three Sierra Norte de Oaxaca *comunidades*, the congruence or mismatch between users of water items (e.g., springs, stream uptakes, or storage tanks) and the land tenure class (village-scale or individual) of their locations is at most only weakly related to whether the tenure classes have been formalized through PROCEDE. In PROCEDE-parceled Talea, the concordance between individual-user water items and individually-owned land is high, as is the concordance between community-user water items and community-owned land. In non-

PROCEDE-parceled Tiltepec, congruence is also generally high. In non-PROCEDE-parceled Yagila, however, congruence is lower. There, about half of the village-used water sources are on de facto individual parcels.

In Talea, sub-village-scale groups, usually organized for commercial production, use water mainly drawn from individual parcels, and the water source parcel owner is rarely a member of the group. One of these groups is functionally equivalent to a population center potable water system: the hamlet of Santa Gertrudis.

In all three villages, the most widespread practice which depends on oral "dyadic" agreements rooted in cohesive village culture is that of an individual parcel owner borrowing water from a neighboring parcel on a long-term basis. The practice is about as common in PROCEDE-parceled Talea (38 percent of the individual use/individual tenure water items) as it is in the non-PROCEDE-parceled *comunidades* (46 percent in Tiltepec, 30 percent in Yagila). In Yagila, similar agreements or tacit understandings are also important for community use of water sources on individual parcels.

7. Results, part 3: Geodata analysis of major springs and land tenure in 2009

The basic question I try to answer in this analysis is: "Are springs[98] more often found in common use areas than one would expect?" I address this general problem through four specific questions:

1. Are springs more commonly located in social property, as compared with private property? The findings mainly concern the "natural endowment" of water resources.

2. Within the social property universe,[99] are springs more densely located in de jure common use areas, as compared with de jure (i.e., PROCEDE-certified) individually parceled areas? Note that there are two kinds of "de jure common use areas": those specifically designated by PROCEDE as common use areas within *núcleos* which also contain individually certified parcels, and those which comprise entire *núcleos* where PROCEDE surveyed only the perimeters. The findings may help describe the current legal situation, but provide only partial insight into the nature of village and individual practices in communities.

3. Within the more limited universe of PROCEDE-parceled *núcleos*, are springs more densely located in common use areas, as compared with parceled areas? These findings more directly address the hypothesis of this study, which is that communities are maintaining village-scale control of water sources. Unfortunately, the universe of *núcleos* with both PROCEDE parcels and significant PROCEDE common use areas is not very large, even though they exemplify the conceptual template for the PROCEDE program (Figure 1.1 on page 14). Because the INEGI springs dataset is also not especially large, one must be cautious in interpreting the results of this part of the analysis.

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[98] The geodata analysis includes just one type of hydrological feature, the "spring", excluding water source points such "*tomas*" (stream uptakes) and deep wells (an uncommon feature within the study regions). See sub-section 1.1.7 (page 26) regarding the importance of springs, symbolically as well as for public health.

[99] To reiteraite, I use the phrase "social property" to mean "all *núcleos agrarios*," notwithstanding the several ways in which social property could be considered a tenuous concept anywhere in post-1992 Mexico (see sub-section 1.1.4).

4. Is there any evidence that, at the moment of PROCEDE certification, *ejidos* and *comunidades* tend to actively incorporate important springs into their newly surveyed common use areas? That is, do they expand their existing de facto common use areas to include springs that otherwise would fall within their newly surveyed individual-parcel areas? Or do they simply tend to codify into a legal cadastre the existing spatial configuration of "parceled" and "common use," without regard to how the legal definition of "individual parcels" might someday interfere with the customary village-scale access to natural resources located on them? This issue can only be addressed by including de facto (i.e., non-PROCEDE-surveyed) parceled and common use areas in the analysis. Because such information can only be obtained through participatory fieldwork, the available data set is quite small. Nevertheless, I tentatively consider the matter at the end of sub-section 7.4.2, drawing from findings for the *comunidades* of Tiltepec and Yagila.

When choosing which springs to include in their 1:50,000-scale maps, INEGI does not simply consider physical size or water output; they also take into account human use and value, partly as a consequence of their use of air photography. This human-defined value bias exists in the PRM data as well. However, this is mostly unproblematic. It is simply a reflection of the social construction of nature, a theme which runs through the cultural ecology scholarly tradition which underlies this study, and which is part of any work addressing the very human concept of land tenure.[100] The most interesting findings I discuss in this chapter are those which underscore how the spatial coincidence of "important" water sources and areas of intense human activity is better described not as a "bias," but rather as an inescapable fact. This fact highlights how local cultural practices as at least as important as legalistic tenure mechanisms for community resource management.

I executed the analysis using the INEGI-mapped springs for each of the two geodata analysis areas separately as well as for both areas as a whole. This was done to illuminate possibly relevant differences between the regions. Besides being home to different indigenous groups, and having rather distinct relationships with the state during various periods in history

[100] One potential problem with this bias is that some places currently lack intense human activity, but do contain natural resources such as large springs, and these resources may someday be exploited for commercial purposes or for long-distance water transport to cities. One approach to materially acknowledging the value of some of these "hidden" resource locations is through Payment for Environmental Services programs (see sub-section 4.5.4).

(up to and including different rates of lukewarm response to PROCEDE), my Oaxaca geodata analysis area happens to be dominated by the Sierras, while about half of my Huasteca area happens to be in the Gulf Coastal Plain. I emphasize that any differences in tenure and water analysis results between the two regions are not necessarily a product of the different indigenous groups and histories of the two regions. If I had extended the Oaxaca geodata analysis area further into the Coastal Plain, or if I had extended the Huasteca area further into the Sierra, certain regional contrasts in my results may have been reduced or eliminated.

In this chapter I begin by discussing the land tenure results without reference to water, first for the Sierra Norte de Oaxaca study area (section 7.1) and then for the Huasteca Potosina study area (7.2). In each section I begin with observations on the land tenure patterns shown in the maps (Figure 7.1 on page 300 and Figure 7.2 on page 305), followed by comments about a few specific villages. After this, I offer observations on the spatial patterns of the INEGI-mapped springs. I continue (7.4) with the main focus of the geodata analysis: an attempt to address the relationships between water sources and land tenure. After presenting the key results tables, I augment the findings with finer-scale participatory research mapping (PRM) data from 14 *núcleos*. I then add the variable of indigenous language speakers to the analysis. I conclude by analyzing the pattern of 2009 CONAGUA water rights concessions within the Oaxaca study region (section 7.5). The results are summarized in section 7.6.

7.1 Land tenure in the Sierra Norte de Oaxaca

The total area of the Oaxaca geodata analysis area, which includes part of the state of Veracruz, is 6,939 sq km. The population is 170,894, of whom about 116,000, or 68 percent, are indigenous language speakers. The average population density is 25 persons per sq km.

There are about 153 *núcleos* mainly or entirely within the area, including approximately 7 with unresolved legal status (see discussion below), as well as around 5 private property villages (i.e., INEGI-defined *localidades* with at least 100 residents).

The average population of the *núcleos* and private property villages is 1,081, while the average area (after subtracting known *terrenos nacionales* from the total area) is 43 sq km. The average population of the 19 *núcleos* subjected to RAN archival research and (in six cases) participatory mapping is 663, while their average area is 38 sq km. As a representative sample of the entire Oaxaca geodata analysis area, the RAN document/PRM study *núcleos* are satisfactory in terms of area, but are significantly smaller in their populations than the regional average.

Before analyzing the Sierra Norte de Oaxaca land tenure map (sub-section 7.1.2), I discuss a land tenure category I had not anticipated: "de facto *núcleos* with unresolved legal status."

7.1.1 De facto *núcleos* with unresolved legal status as social property

As I began to exhaust the available sources to build a land tenure coverage (see section 4.4), the presence of "leftover" areas, especially in Oaxaca, led to my awareness of the existence of de facto *ejidos* and (more commonly) *comunidades* which have not even been given a chance to accept or reject PROCEDE, because their legal status as social property was never resolved by legal authorities. Universidad Autónoma Metropolitana anthropologist Ana Paula de Teresa Ochoa (1999, 5) found that there were five *municipios* (counties) in the Chinantec-dominated highlands (the northeastern quarter of my Oaxaca geodata analysis area) which contained such villages: "Even if the RAN does not recognize *núcleos agrarios* within [these five *municipios*], because they don't have [legal] agrarian actions filed [*instaurada*], they can be considered as such because they possess their own territories, shared with several annexes." De Teresa asserts that such places are especially vulnerable to conflicts with private property owners, and may eventually find themselves declared private properties. This would be ironic, since they would likely be among the very last *núcleos* to choose *domino pleno* (full privatization).

To locate and estimate the territories of these *núcleos* as best I could, I relied first on de Teresa's 1999 article. For areas of Oaxaca outside the Chinantla, the next source I consulted was the official publication of the resolution among SRA, INEGI, RAN, and Procuraduría Agraria which began to bring the PROCEDE process to a close in Oaxaca state (SRA 2006). This document contains two helpful appendices: a list of *núcleos* which have rejected PROCEDE (along with whether their status as a *comunidad* or *ejido*, their area, and their "maximum advance" in or towards PROCEDE work), and a list of "*núcleos agrarios con imposibilidad* *legal*." The latter list is of villages which are recognized by *someone* in the government as *núcleos*, but with severe legal problems or insufficiencies. I assigned places in the first list to the category "*núcleos* without PROCEDE survey." Places in the second list were assigned to this category as well, unless their surface area was listed as "zero," in which case I places them in the "de facto *núcleo*, status unresolved" category, because their lack of any kind of officially recognized survey implies that their claims to *núcleo* status are not likely to be resolved soon. Finally, for any villages[101] still left over, in the Huasteca as well as in Oaxaca, I performed an Internet search for any documents or news items from which I could at least make an educated guess about its tenure situation. These steps left me only with a few small areas of truly unknown tenure status (Figure 7.1) which had to be excluded from the quantitative analysis.

7.1.2 Land tenure in the Oaxaca study area: General observations

To ascertain how representative is the sample of 19 RAN document study *núcleos*, I calculated the percentage of each broad tenure category within the geodata analysis area. Because they are an artifact of the arbitrary study area boundaries, these surface area percentages have no deeper significance than this. I did not include areas of unknown tenure in the calculations. The results (Table 7.1) show that the archival study sample does represent the

Table 7.1: Percentages of the Oaxaca geodata analysis area in each general land tenure category, compared to the RAN document study and PRM *núcleos* in the same area.

	Mostly common use (all types)	Mostly PROCEDE-certified parcels	De facto social, status as *núcleo* unresolved	Private	Federal
Entire Sierra Norte de Oaxaca study area	81	10	6	2	1
Sample of 19 *núcleos*	84	14	0	2	0

[101] For this task, I researched all INEGI census *localidades* with at least 100 residents.

overall area remarkably well.[102] (Note that, while I never intended the RAN document sample to include private property, the legal judgment which declared Yatzona to be "private" resulted in its inclusion anyway. Interestingly, Yatzona contains an INEGI-mapped spring).

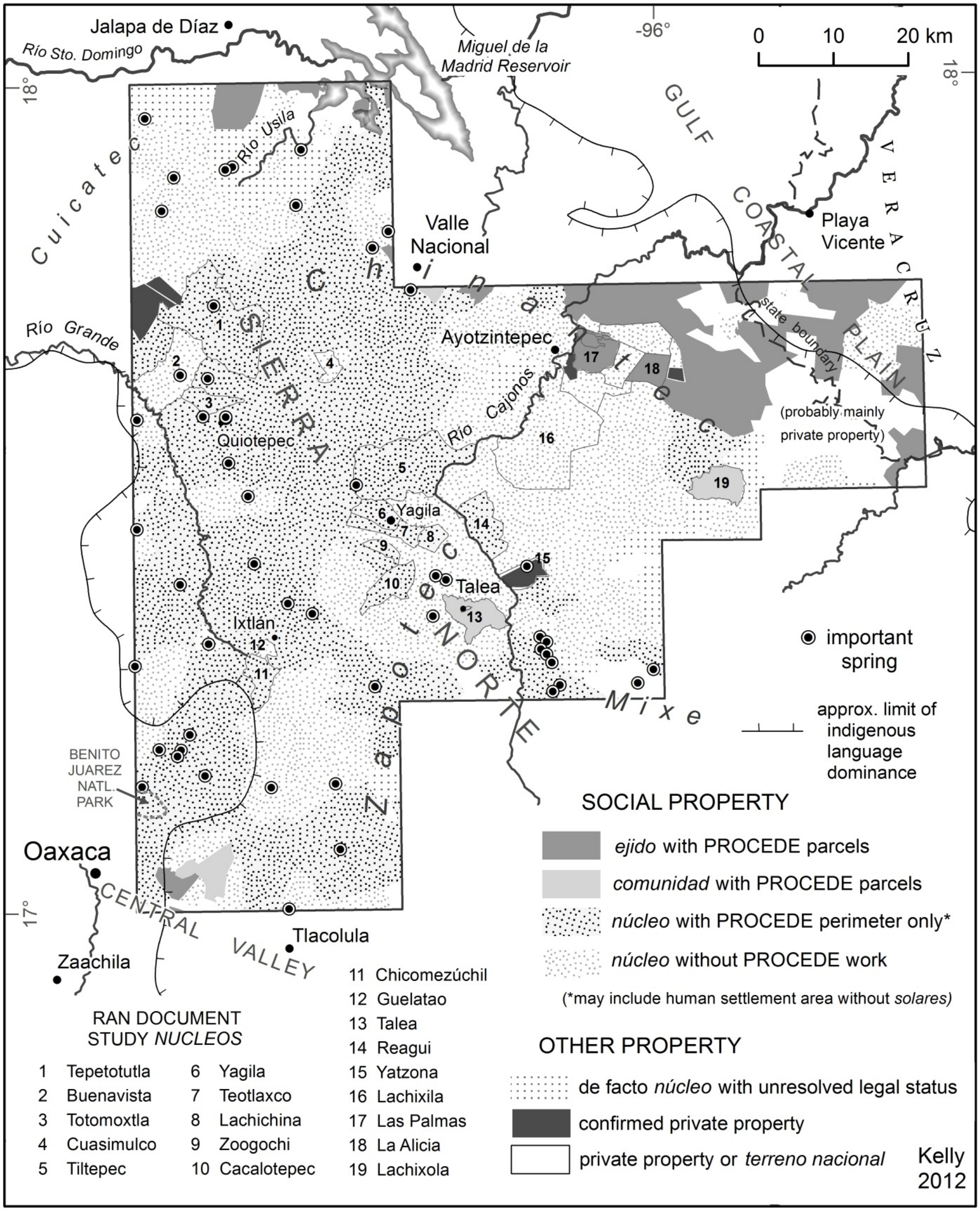
The geodata analysis results maps for the Oaxaca study area (Figure 7.1) and the Huasteca study area (Figure 7.2, on page 305) show the INEGI-mapped springs and land tenure classes. The maps show as many of the land tenure classes used for the quantitative analysis as possible, given the legibility limitations of the map scale. In this map we can see how social property extends well into the coastal plain, even beyond the lowland Chinantec-speaking zone, although it is probable that much of the white space around the Oaxaca-Veracruz state border is private property (Clarke 2000, 246). The Chinantecs living on the coastal plain inhabit *ejidos*, most of them parceled by PROCEDE, rather than *comunidades*. This reflects the 20th century origins of most of these villages, as development spurred by the Papaloapan Commission attracted some highland Chinantecs to move downslope. A 1960s investigation found that "the instability of community relations under the impact of such outside forces presented complexities not encountered in the study of villages of the Sierras" (Luebke 1968, 37).

The overall pattern of land tenure shows some truth to the stereotype which equates the "Sierras" with "resistance to PROCEDE," and the "plains" (and Central Valley) with "full acceptance of PROCEDE parceling, plus private lands," regardless of indigeneity. However, I found numerous departures from this generalization, as well as more subtle patterns within it.

Two bands of "de facto, unresolved" *núcleos*, interspersed with a few PROCEDE-parceled *núcleos*, extend from the coastal plain well into the Sierras. One is the valley of the Río Usila, at northeast extreme of Chinantec speakers. This valley is known for its high rainfall and patches of well-conserved humid tropical forest (Figure 2.5, on page 56). Its apparently tenuous legal expression of village orientation may be related to its being one of the main catchment areas for the Papaloapan Basin project's Miguel de la Madrid Reservoir. After decades of

[102] While different sources give somewhat different figures, the surface area totals for the entire state of Oaxaca is about 74 percent social property (about 62 percent of this in *comunidades* and 38 percent in *ejidos*) and 26 percent private (Clarke 2000, 246; Álvarez 2003, 367).

Figure 7.1. Oaxaca geodata analysis area: Land tenure in 2011, and springs included on INEGI 1:50,000-scale maps. White areas are of unknown tenure status, and are not included in analysis. (Sources include INEGI 2011).



elevated interaction with the state, some village identity may truly have been lost, but this has likely been reinforced by the state's special incentive to downplay whatever village identity still exists in this area of particular "national interest."

The second corridor of tenure uncertainty and scattered full acceptance of PROCEDE is near the southeast extreme of Chinantec speakers. This zone follows the boundary between the Colorado and Cajonos watersheds (Figure 2.4, on page 53), including the *núcleo* of Lachixola, and up to the lightly populated highlands where the Chinantec, Zapotec, and Mixe language areas meet (Figure 2.6, on page 59). I currently have no specific explanation for this region's tenure orientation, except to observe that this corridor has a history of an unusually vigorous blending of individual-oriented commercial agriculture (mainly mango in the lowlands, and cattle ranching further up) with indigenous culture. Talea is not far from this corridor, and shares some of its traits. I consider this matter further (sub-section 7.2.1) with the case of Lalana, the de facto *núcleo* which borders Lachixola to its northeast. This corridor, essentially a *mestizo*-indigenous interaction zone, should be considered for future research. The Huasteca *núcleos* investigated by the México Indígena project are located within a similar corridor, in terms of physiography, ethnicity, and land tenure patterns.[103]

Within the Sierra zone of "resistance to PROCEDE," there is noteworthy clustering of the two principal strategies. *Núcleos* which only had PROCEDE (or FANAR) survey their perimeters are concentrated in a zone extending from the highland Chinantec-speaking villages around Quiotepec to the ethnically Zapotec (though not necessarily Zapotec-speaking) villages between Ixtlán and the Central Valley. The *núcleos* which did not do any PROCEDE work at all are concentrated in the Zapotec-language-dominant highlands from the Cajonos valley to the

[103] If this zone were located in a country or region without such a long history of uninterrupted, relatively dense human occupation, this band might be termed a "colonization front" (Herlihy 2003, 315). In the present study areas, it is a front of "colonization" only in a less literal sense of the word: a line of expanding commercial agriculture, especially cattle ranching. In the context of Oaxaca, Colin Clarke refers to the band between about 400 and 1700 meters in elevation – most of the Sierra Norte's northern slope – as "*tierra templada*" [temperate land]. Neither as hot as the coastal plain below it, nor as cold as the highest mountains above it, Clarke characterizes it as a "contested zone, with histories of land conflict between estates and small farmers. Communal land is literally above these conflicts, occurring in the *tierra fría*" [cold land] (Clarke 2000, 245).

"*mancomunados*" villages southeast of Ixtlán.[104] Based on my field experiences, I suspect this clustering of strategies may in part be due to the influence of regional rural development/political NGOs such as UNOSJO (Unión de Organizaciones de la Sierra Juárez de Oaxaca). These groups appear to be gradually replacing the role of *núcleo*-specific "*maestros*," non-indigenous primary and secondary school teachers whose leftist organizing (not always welcome in the communities) was cited from several historical documents in chapter 5.

7.1.3 Notable examples encountered while constructing the Oaxaca land tenure coverage

Lalana is the de facto *núcleo* "*con imposibilidad legal*" (SRA 2006) just northeast of the PROCEDE-parceled *comunidad* of Lachixola (location of Lachixola shown on Figure 7.1, in page 300). The white space just bordering Lalana to its northeast is the land in and around the village of Zaragoza, which one agroecologist asserts is private property (Delgado García 2007). While I show these three places as belonging to different tenure categories, in a deeper sense they are all part of the same phenomenon: villages that are, culturally and to a degree legally, "in between" social and private property. Anecdotal images and descriptions I found in Internet conversations, as well as air photographs, suggest that these places engage in many village-oriented practices such as *barrio*-specific fiestas and perhaps *cargos* (rotating village leadership posts) or the occasional *tequio,* but that they also emphasize private, individual property ownership, much of it on land devoted to cattle ranching. Lalana's private property orientation is also attested in a government report (SRA 2006). In the Huasteca Potosina, the same sort of mix is found in some *núcleos* also located at the edge of the coastal plain. For example, the lowland parcels which comprise almost half of the *ejido* of La Pila are not easily distinguishable in air photographs from neighboring privately owned ranches.

In Lalana and villages around it, there appear to be cases where the state is expressing its own internally conflicting attitudes toward the concept of social property in the post-1992 era. The Lachixola PROCEDE map (INEGI 2002a) describes Lalana as "*terrenos comunales*" (i.e., as social property), suggesting that the RAN equates it with other well-established *núcleos* that

[104] About 20 km beyond the geodata analysis area to the northwest, there is another noteable cluster of non-PROCEDE nucleos inhabited by indigenous Mazatecs.

have rejected PROCEDE on their own initiative, while the reality on the ground seems to be oriented closer to individual, essentially private parcels.

The case of Comaltepec illustrates a different sort of miscommunication among the branches of the Mexican government. This low-population-density *comunidad* had its perimeter surveyed by FANAR in 2008. The 18,366-ha, nearly 40-km-long polygon snakes all the way from a ridgeline just above the town of Valle Nacional, past the *núcleo* of Cuasimulco, almost to the Río Grande near the *comunidad* of Quiotepec. While this polygon does not overlap with any of the *ejidos* or *comunidades* already surveyed by PROCEDE, it does spill far out of the Comaltepec *municipio* to include portions of three other *municipios,* as they are defined by the INEGI "*marco geoestadístico*" shapefile as well as within the PHINA database (RAN 2009-12). (I should note that these two government sources also sometimes contradict each other.) I am not aware of any conflicts which have specifically arisen from Mexico's apparent tolerance of a mismatch between its *núcleo* and *municipio* boundaries, but there have been serious clashes caused in part by discrepancies between both of these boundary types and *state* boundaries, e.g. between the states of Yucatán and Quintana Roo (Sánchez 2011) and, more violently, in the Chimalapas region between Oaxaca and Chiapas (Matías 2012).

7.2 Land tenure in the Huasteca Potosina

The total area of the Huasteca geodata analysis area, excluding the city of Ciudad Valles, is 3,523 sq km. The population is 420,594, of whom about 195,000, or 46 percent, are indigenous language speakers. The average population density is 119 persons per sq km.

There are about 316 *núcleos* mainly or entirely within the area, including approximately 3 with unresolved legal status, as well as around 15 private property villages (i.e., INEGI-defined *localidades* with at least 100 residents).

The average population of the *núcleos* and private property villages is 1,271, while the average area (after subtracting known *terrenos nacionales* from the total area) is 10 sq km. The average population of the fifteen *núcleos* subjected to archival and (in nine cases) participatory research is 1,095, while their average area is 15 sq km. As a representative sample of the entire

Huasteca geodata analysis area, the RAN document/PRM study *núcleos* are satisfactory in their populations, but are somewhat larger in terms of area than the regional average.

7.2.1 Land tenure in the Huasteca study area: General observations

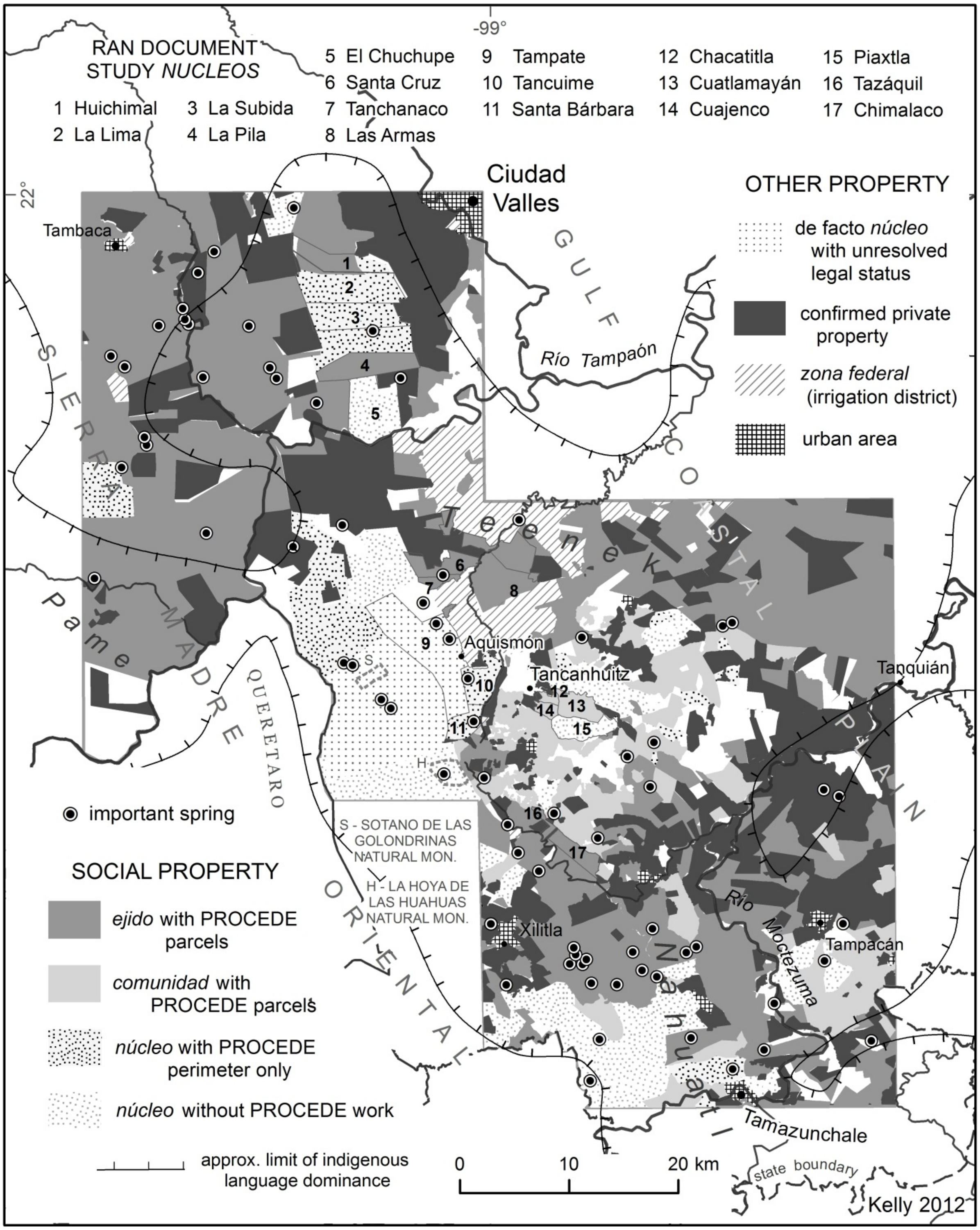
The RAN document/PRM study *núcleos* (Table 7.2) overrepresent common use land and territories with unresolved status as *ejidos* or *comunidades,* and underrepresent parceled areas, when compared to the whole geodata analysis area. This holds true even after discounting private and federal lands, which I never intended to subject to archival and participatory research. This disparity is less severe when the sample is considered as a collection of *núcleos* rather than as a dispersed sum of areas, because the ones with significant common use areas tend to be larger than others.

Table 7.2: Percentage of the Huasteca geodata analysis area in each general land tenure category, compared to subset of *núcleos* subjected to detailed study. Values in parentheses exclude private and federal lands.

	Mostly common use (all types)	Mostly PROCEDE-certified parcels	De facto social, status as *núcleo* unresolved	Private	Federal
Entire Huasteca Potosina study area	26 (37)	38 (56)	5 (7)	28	3
Sample of 15 *núcleos*	67	14	19	0	0

The geodata analysis results map for the Huasteca study area (Figure 7.2) shows the distribution of INEGI-mapped springs within land tenure classes. About half of the study area is in the Gulf Coastal Plain (including the large lowland valleys near the town of Tambaca), in contrast to the Oaxaca study area, where only a small portion is in the Coastal Plain.

Figure 7.2. Huasteca geodata analysis area: Land tenure in 2011, and springs included on INEGI 1:50,000-scale maps. White areas are of unknown tenure status, and are not included in analysis. (Sources include INEGI 2011).



In general, the land tenure pattern in the Huasteca study area shows variation and heterogeneity, at several scales, to a much greater degree than the pattern observed in Oaxaca. As in Oaxaca, social property dominates, even far into the coastal plain. There are, however, three large areas dominated by non-social property:

1. The private property zone, mainly sugar cane farms and cattle pastures, on the plain near Ciudad Valles.

2. The federal zone remnants of the World Bank-funded Pujal-Coy Irrigation District and, continuing to the west, an area of upland private properties between El Chuchupe and Tampate.

3. A large area of mainly private properties in the lowlands surrounding a stretch of the Río Moctezuma, but extending toward the low sandstone hills east of Chimalaco, where these private parcels border PROCEDE-parceled *comunidades*. A finger of private property continues westward along the highway up to Xilitla, a town surrounded by a small area of privately owned coffee plantations.

The first of these zones is mainly *mestizo* (Figure 2.3, on page 51). The second zone contains mainly Teenek speakers, in both the irrigation district and the upland private property area. The Pujal-Coy irrigation project (see section 3.4) was a federal scheme to pump water from the Río Tampaón for use by small-scale commercial farmers (Whiteford et al. 1998, 385). *Ejidos* in the project area were formed in the usual way, mainly by state expropriation of large private farms. More of the *ejido* settlers came from distant regions than is typically the case. As "few *ejidatarios* [could] afford to irrigate because of rising water and labor costs," de facto individual parcel ownership and management became common (Whiteford et al. 1998, 386).

The private property uplands west of the irrigation district include part of a long, rounded limestone ridge which extends from beyond the northern boundary of the study area southward to Santa Cruz (Figure 2.1, on page 47). This 5-km-wide ridge, called Sierra La Pila or Sierra Las Anonas by INEGI, and T'sum T'sum T'zon or Sierra Papatla by Teenek residents of La Pila, is remarkable because almost every land tenure category is represented in one segment or another. Besides these private parcels, the ridge includes "PROCEDE-surveyed common use areas within *ejidos* with PROCEDE parcels" (e.g., La Pila); "de facto common use areas in *núcleos* with only their perimeters surveyed by PROCEDE" (e.g., La Lima); and "*núcleos* without PROCEDE work" (e.g., El Chuchupe). A slightly more rugged ridge which begins just to its south even includes parts of a "de facto *núcleo* with unresolved legal status" (Tampate). Despite this hodgepodge of land tenure categories, the entire ridge appears essentially uniform in air photographs: scattered *milpas* (many of them rotative "slash and burn" plots), and few small permanent ranches, as well as, perhaps, a few plantations of illicit substances, all within a matrix of medium-canopy humid tropical forest on rather poor soils. Only the eastern edge has deeper soils, permitting a mix of crops and fruit orchards known in Teenek as *te'lom* (Alcorn 1983).

The third zone of mainly private property contains many Nahuatl speakers, especially in a corridor between the towns of Tanquian and Tampacan, but it is also inhabited by many *mestizos* concentrated near the Río Moctezuma. The slightly hillier part of this zone east of Chimalaco contains a mix of indigenous and non-indigenous language speakers.

In contrast to Oaxaca, the Huasteca Potosina geodata analysis area lacks a very large area of non-compliance with the standard PROCEDE template. In the Huasteca, the corridor of non-PROCEDE-parceled *núcleos* stretching southward from Tampate suggests that, as in Oaxaca, the higher Sierras are a zone of PROCEDE resistance. However, the indigenous Pame-speaking zone which includes the northwest part of the Huasteca study area is also mountainous, yet nearly all the *núcleos* here are *ejidos* with PROCEDE parcels, interspersed with some private properties which are larger than the scattered *pequeñas propiedades* of the Sierra in Oaxaca. A closer look at the part of the Pame region included within the geodata analysis area reveals that this zone is not nearly as topographically rugged as the high Sierras further south. As Figure 2.1 (page 47) suggests, this is actually a karstic area of flat, low-elevation, deep-soil dolines, planted mainly in sugar cane, surrounded by low-population-density wooded hills with a few farms, ranches, and hamlets. Census data reveals that the villages in the fertile dolines are mainly *mestizo*, while the settlements in the hills are more purely Pame. Both settlement types are in PROCEDE-parceled *ejidos* which sometimes border private properties. I will discuss the example of Tanlacu in subsection 7.2.2 below. The situation is similar to that in the Oaxaca *ejidos* of Las Palmas and La Alicia (Figure 7.1, on page 300). In both cases, the presence of indigenous *ejidos* (not *comunidades*) suggests a history of relatively recent indigenous settlement – or, more likely, *re*-settlement. As in Oaxaca, physiography is a somewhat better predictor of land tenure regimes than indigeneity.

In Oaxaca, *comunidades* (not *ejidos*) with PROCEDE-certified individual parcels are rare, Talea being one. In the Huasteca, I was surprised to find that this is a much more common occurrence. There are two major clusters of PROCEDE-parceled *comunidades*. The larger cluster comprises most of the land area of the Nahua-dominated low sandstone hills, known to some as the Sierra de Tancanhuitz, which form a 25-km half circle extending southeast from the town of that name. Only the southern half of this cluster consists of *comunidades* like Talea, with many individual parcels. The northern half mainly contains *comunidades* which, like Cuatlamayán, innovatively declared their de facto parceled areas to be de jure "common use," letting PROCEDE survey only a few, civic parcels. (The distinction between the two tenure strategies is not visible in Figure 7.2). The settlement pattern of all *núcleos* in these hills is the same: dispersed houses with permanent occupation on small plots, with some large trees on most plots and wooded strips at steeper slopes, but no large forested areas.

The second, smaller cluster does contain "conventional" parceled *comunidades* similar to Talea. It is located in a Nahuatl-speaking area with low hills (visible in Figure 2.1, on page 47, as the boundary between the Moctezuma and Tempoal watersheds), around the town of Tampacan.

In summary, the pattern of land tenure categories in the Huasteca Potosina conforms to what might be expected for such a location. The Teenek region is essentially the extreme northern end of a long, discontinuous strip of indigenous settlements clustered around the first mountain range inland from Atlantic coastal plain. The strip continues southward through northern Oaxaca and Chiapas, into the Ixil and Kanjobal territories of Guatemala (where this "first mountain range" is now far inland, due to the presence of the Yucatán Peninsula), to the Tol (Jicaque) of Honduras (living just inland from the narrow coastal plain), then the Tawahka, Pech, Miskito, and others in Honduras and Nicaragua (where the coastal plain widens again – even more than in Yucatán, this time occupied mainly by indigenous peoples all the way to the Caribbean coast), and on through the Bribri-Cabécar of Costa Rica and the Ngöbe of Panama (where the coastal plain again narrows and disappears), and even into the Sierra de Santa Marta, Colombia, home of the Kogi and Arhuaco. These cultures have many differences, but they share certain physiographic characteristics (including high rainfall, and – where the topographic conditions allow it – cloud forest), as well as a generalized history of being "pushed back" by non-indigenous groups, to varying degrees, from the plains and into the mountains (or, as sometimes in Moskitia, from the mountains into the plains), and of finding accommodation with the state (e.g., in legal land tenure practices) in areas more exploitable for commercial agriculture (usually the plains), while confronting the state more vigorously in less exploitable areas (usually the mountains, although again in Moskitia this pattern is sometimes reversed).

7.2.2 Notable examples encountered while constructing the land tenure coverage

I will discuss three interesting examples from the Huasteca geodata analysis area. The first two share a common theme: land tenure decisions in places where separate indigenous and *mestizo* settlements nonetheless consider themselves, in some ways, to form a single "community."

The large-area *núcleo* of Tanlacu, part of which lies outside the geodata analysis area, covers much of the mixed Pame-*mestizo*, karstic hill-and-valley zone described above. Its human settlement areas, parceled areas, and common use areas were surveyed in two stages: part of the *ejido* by PROCEDE in 2005 and the rest by FANAR in 2010. In its final form, it has ten settlement areas (four of them with over 100 residents each), three large parceled areas (together comprising about 40 percent of the territory), and the rest in common use.[105] One of the large parceled areas is the largest fertile-soil, flat valley, which also contains the largest village (called "Tanlacut" in INEGI maps) and six other settlements, all of them mainly *mestizo*. The other large parceled area within the study area is a rugged, mountainous zone with scrubby secondary vegetation, extending up to 3 km from the canyon of the Río Santa María; it is anchored at its ends by two Pame-dominant settlements. There is an additional Pame hamlet surveyed as a human settlement area deep within the common use area.

Tanlacu offers an example of indigenous and *mestizo* villages acting, in legal terms, as a single *núcleo*. The second example, Matlapa, has a similar condition, but here the local residents have instead chosen to be considered as two separate *núcleos*, with different responses to PROCEDE. The two communities which share the name "Matlapa" could not be more explicit in their distinguishing characteristic: the official name of one is "Matlapa Indígena," while the other

[105] There is an INEGI-mapped spring just within the common use area, about 1 km from the main population center, for whose potable water system it likely serves as the source.

is officially "Matlapa Mestizos." Matlapa Indígena is a 2-polygon *ejido* with 3,400 residents (60 percent of whom speak Nahuatl), and did not do any PROCEDE work; its location appears in Figures 2.1 and 2.2 (pages 47 and 49). Matlapa Mestizos (also called "Colonia Escalanar") is an *ejido* with 405 residents (none of whom speak Nahuatl), and had PROCEDE survey its individual parcels (SEDESOL 2011). However, Matlapa Mestizos also contains a 4.5-ha PROCEDE-surveyed common use area which was clearly located there, at least in part, specifically to legally protect the common use status of the INEGI-mapped water source within it – a rare instance where the data sets used in this analysis allow us to directly observe this practice.

The last example is the one instance when my uncertainty about which land tenure category to assign to an INEGI-mapped spring led me to discover a potential direct conflict between private property owners and non-indigenous-language residents (or, alternatively, an error in the ASERCA shapefile of private properties). The place is called La Cuchilla, in the mountainous part of the *municipio* of Aquismón, near the confluence of the Río Gallinas and the Río Santa María. The 400 "poor" inhabitants evidently consider themselves a "*comunidad*" (Plano Informativo 2011), yet part of their territory is apparently in private hands, while the rest lacks official *núcleo* status.

7.3 Major springs in both geodata analysis areas

When considering the pattern of springs INEGI included in its 1:50,000 maps, I will refer to the watersheds shown in Figure 2.1 and 2.4, in chapter 2. In this section, "springs" refers to this INEGI dataset (see sub-section 4.4.2 for an analysis of the limitations and characteristics of this dataset, particularly its apparent bias toward human use). At the end of this subsection, I will briefly consider the few additional springs which appear in other INEGI hydrology shapefiles.

The Sierra Norte de Oaxaca geodata analysis area (Figure 7.1, on page 300) mainly comprises parts of four watersheds. Despite its high rainfall, the relatively small Valle Nacional watershed contains only a few springs, perhaps (given the data's human-use bias) because its slopes are thickly forested and thinly settled. The Verde watershed – i.e., the Central Valley – also contains few springs, probably due to its drier climate; its inhabitants are increasingly dependent on groundwater.[106] The two major watersheds within the study area, the Grande and the Cajonos, each contain many springs, although there are none in the lower (northern) half of the Cajonos watershed.

In the Grande watershed, an important group of well-spaced springs is located within the 2000-to-2500-m-elevation band in long stretches on both slopes above the upper Río Grande. Many of the springs are located just above population centers; this is surely in part because some of those villages were founded at their locations due to their proximity to water sources. One cluster of springs within this group is found in the pine-oak forests of the upper (southern) portion of the *núcleo* territory of Ixtepeji, halfway between Oaxaca City and Ixtlán. These springs are located between the hamlet of El Punto (on the main highway crossing the Sierra Norte) and Cerro San Felipe, a peak conspicuously visible from Oaxaca City. Another cluster lies within the Chinantla Alta area, centered on the *comunidad* of Temextitlán, near Quiotepec. A smaller concentration of springs in the Grande watershed is found between 500 and 1000 m elevation, in and around the tropical forests above the Río Usila. This is the only significant cluster of springs at such a low altitude, and their existence was likely a factor in the Papaloapan Commission's planning of the Miguel de la Madrid Reservoir.

In the Cajonos watershed, there is a remarkable concentration of springs above and between the settlements of Villa Alta and Yaa, a Zapotec-speaking *núcleo* 9 km to the south. These springs are between 10 and 15 km southeast of Talea, and lie just below the crest of a ridgeline which continues into the Mixe-dominant territory outside the study area. There are probably other important concentrations of INEGI-mapped springs south of the study area along the rim of the uppermost segment of the Río Cajonos Valley. When I drove through this area after completing my Talea fieldwork, I encountered one telling example: a spring in a forested upper zone of the territory of San Pedro Cajonos, a Zapotec community whose location appears in Figures 2.4 and 2.5, on pages 53 and 56. The spring has water conduits extending from it, and

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[106] "The history of water use in the Central Valleys is one of increasing abstraction [i.e., extraction] at the outer edge of the drainage network leading to a decrease in water availability downstream in the Atoyac [River] itself. More and more water has been taken from the perennial tributaries at their points of entry into the valley. Water has been used upstream of Oaxaca City in the Etla Valley by increasing the use of the high water-table zone and extending and modernizing canal systems. Abstraction has been multiplied many times over by the increasing number of wells with mechanical pumps, to the point that groundwater reserves are threatened" (Clarke 2000, 94).

is enclosed by a fence and locked gate, encased in a beautiful stone structure adorned with religious symbols. It is marked with a hand-painted road sign which reads:

> LET'S TAKE CARE OF THE FOREST AND THE WATER. Prohibited: Washing vehicles or polluting stream water, hunting wild animals, dumping trash in the forest, and removing [*saqueo*] wood, pine seedlings, fertilizer, hay, moss, etc. Respectfully, *Comisariado* de Bienes Comunales and Consejo de Vigilancia, San Pedro Cajonos, Oaxaca.

The Huasteca Potosina geodata analysis area (Figure 7.2, on page 305), unlike the Oaxaca one, is located far from the true headwaters of major rivers. The Río Santa María/Tampoán originates near the borders of western San Luis Potosí state and Guanajuato state, while the Río Moctezuma's upper tributaries arise deep within Hidalgo and Querétero states, and even within the limits of Mexico City, where in 1607 a canal was built to it to drain Lake Texcoco (Wolf 1959, 6). Due to its karst geomorphology, many streams "disappear" in the hills of the Sierra Madre Oriental and re-emerge as major springs within the study area.

All but two of the INEGI-mapped springs in the Huasteca study area are located near the base of these limestone hills. Some are found where a ridge meets the Gulf Coastal Plain (e.g., the line of springs from Tampate to southwest of Tazáquil), while others are within the Sierras, along the margins of flat, deep-soil doline valleys (e.g., a cluster southeast of Tambaca, near the northwest corner of the study area). In both situations, such places are often where more community-oriented property in the hills borders more individually-oriented property in the valleys and plains. In some cases, this is expressed as "social property" (of any type) bordering "private property," while in other cases it is expressed within a social property *núcleo* as a "common use area" bordering a "parceled area" (whether de facto, or converted to de jure status by PROCEDE surveying).

The most extraordinary cluster of springs in the Huasteca study area is about 8 km southeast of the town of Xilitla. These springs are on the steep slopes of a sharp ridge which reaches 1000 meters in elevation, generating tremendous orographic rainfall. The cluster lies between the populous Nahuatl-speaking villages of Itzacapa (1,300 inhabitants) and Ahuehueyo (1,200 inhabitants). The latter is one of four villages, plus several smaller settlements, which make up the *ejido* of El Cristiano y sus Anexos.[107] All six INEGI-mapped springs within this *núcleo* are within the PROCEDE-surveyed parceled area. However, close inspection at the GAIA coverage reveals that three of these springs are probably actually in "common use" areas, broadly speaking: one is 30 meters (within the INEGI tolerance of error) from a tiny parcel whose size and shape is similar to known civic parcels in other *ejidos* and *comunidades*; another is at the edge of a stream right of way, not in any parcel despite its being in the "parceled area"; and the third spring is in what appears to be a small water body right of way, next to a civic parcel which may contain its water storage tank. The protocol of the geodata analysis demanded that I avoid speculation, and assign all three of these springs to the "PROCEDE-parceled" land tenure category.

In Figure 7.2, several springs are depicted within the general region of the Gulf Coastal Plain, but in fact all but two are located along the edges of sandstone hills (either the Sierra de Tancanhuitz, or the smaller hills around Tampacán). Even the spring along the Río Oxitipa/Coy (visible within the word "Teenek") is at the edge of an isolated small hill, the same hill which comprises the forested common use area of the *ejido* of Las Armas. This spring is shown on the INEGI topographic maps as feeding an impressive system of water conduits, including an 11-km pipe which delivers water to at least four *ejidos*. Only two springs, near the Río Moctezuma, are deep within the true alluvial-soil plain.

Adding the augmented INEGI water source shapefiles (INEGI 2009) to both geodata analysis areas did not appear to change the overall patterns observed when using the topographic "springs" coverage alone. A few new localized clusters did emerge, however, which may merit further investigation in the future. The augmented INEGI springs for the Oaxaca study area are visible in Figure 7.6 (page 337) as the smallest empty circles. The only new group is a line of five springs stretching southward from Valle Nacional for 30 km. These are all within 500 meters of the trans-Sierra highway, along the spine of a forested ridge that is almost entirely uninhabited, on land belonging to Comaltepec, a *núcleo* whose perimeter was only recently surveyed. Pending further research, it seems probable that these springs were opportunistically

[107] Whatever the sociopolitical consequences of PROCEDE, this *ejido* is a spectacular testament to the sheer work accomplished by the program. The GAIA online GIS portal (INEGI 2011) shows it to be divided into thousands of small parcels of many shapes.

included by government personnel for their convenient locations along a main highway, although it should be noted that this segment of highway does pass through well-conserved cloud forest, and several tributaries of the Valle Nacional river system originate here.

Adding the additional INEGI springs layer (INEGI 2009) to the Huasteca study area produced a sprinkling of new springs (not shown on any map in this study). There are two modest clusters: a group of five spread over the Sierra de Tancanhuitz (some on private property, others within "inverted" civic-parcels-only *núcleos*), and another group of six dispersed across the Gulf Coastal Plain's PROCEDE-parceled *ejidos*. All are listed as for "domestic" or "domestic and cattle ranching" uses. One of the springs in the augmented data set is within the México Indígena participatory mapping *ejido* of La Pila. It appears to be one of the "*pozos*" included by the community in their map, near the largest human settlement area, along a multi-*núcleo* potable water pipeline.

7.4 Relationships between major springs and land tenure

In each of the subsections which follow, I begin by considering the geodata analysis areas in their entirety, and continue by focusing on progressively smaller subsets within these areas (e.g., "PROCEDE-parceled *núcleos*").

To reiterate, there are four main questions. Are springs more commonly located in social property, as compared with private property? Within the social property universe, are springs more densely located in de jure common use areas, as compared with de jure (i.e., PROCEDE-certified) individually parceled areas? Within the universe of PROCEDE-parceled *núcleos* within social property (i.e., excluding perimeter-only ones) are springs more densely located in common use areas, as compared with parceled areas? Is there any evidence that, at the moment of PROCEDE certification, *núcleos* tend to actively incorporate important springs into their newly surveyed (but generally de facto pre-existing) common use areas?

Neither the study-area-wide land tenure data, nor most of the participatory data, captures the distinction between purely de facto "common use" and individually "parceled" areas; that is, these tenure areas within *núcleos* that only had their perimeters surveyed by PROCEDE, or which avoided PROCEDE work altogether. Thus, the geodata analysis results focus on *legal* land tenure classes, not the actual land tenure practices I analyzed, for example, in Tiltepec and Yagila (section 6.2). I will briefly consider de facto land tenure at the end of subsection 7.4.2, but these results must be considered tentative, due both to the small sample size and to the spatially inexact nature of the de facto land tenure coverage.

The numbers in the tables in this section refer to the "number of observed springs, compared to number of expected springs, after normalizing as if every sample size were 100." For example, in Table 7.7, the figure for "human settlement areas" is "+9.6." This means that, given an even distribution, one would only expect 1.2 springs – i.e., about one or two of them – to be found in this tenure category. Instead, 12 springs were found in this tenure category, a "surplus" of 10.8. Because there are 112 total springs in this sample, this quantity normalizes to 9.6. In each table, in tracing any path through the cells from top to bottom, the values sum to zero (after accounting for minor rounding errors).

The overall average density of INEGI-mapped springs is considerably higher in Huasteca geodata analysis (about 1 spring for every 8,300 ha) than in the Oaxaca one (about 1 spring for every 13,900 ha).[108] Because of this, the results for any tenure category with very different relative proportions in the two study regions will appear odd. For example, the result for "only *núcleo* perimeter surveyed" is mildly positive when considering each study region separately (Tables 7.5 and 7.4), but strongly negative when considering both study regions together (Tables 7.3 and 7.7).

As a separate, minor exercise, I investigated the existence of government-recognized "natural protected areas" within the two study areas, including state parks, national parks, and biosphere reserves. Although the de jure land use restrictions within such areas vary widely, and the de facto land use practices vary more widely still, it was important to tentatively explore how these entities relate to land tenure and to important water sources. This is a fruitful theme for future research.

[108] The higher density of springs in the Huasteca study area is partly due to the greater preponderance of karst geomorphology, but mainly is due to the greater population density and concentration of villages. This underscores the idea that "human use" was a key criterion for a spring's inclusion in the INEGI data set.

There are three state or federal protected areas within my geodata analysis areas.[109] The two protected areas in the Huasteca Potosina area (Figure 7.2 on page 305) are:

1. Sótano de las Golondrinas Natural Monument, a 280-ha polygon which includes a famously deep and wide sinkhole. In my land tenure coverage, it is within the orbit of Tamapatz, a "de facto social property, status as *núcleo* unresolved" community (probably mainly *terreno nacional*) that is principally *mestizo*, at least linguistically.

2. La Hoya de las Huahuas Natural Monument, a 400-ha polygon which contains one of the INEGI-mapped springs. In my land tenure coverage, it is in the non-PROCEDE Teenek-speaking *núcleo* of Tampaxal; effectively, then, it is common use social property.

The one protected area partly within the Sierra Norte de Oaxaca study area (Figure 7.1 on page 300) is Benito Juárez National Park, decreed in 1937. One INEGI-mapped spring lies just outside its borders. The portion of this 2,600-ha park within the study area is in the higher-elevation section of San Andrés Huayapam, a mainly non-indigenous-language *núcleo* which had only its perimeter surveyed by PROCEDE, and so is all de jure common use.

While using the PHINA *núcleo* tenure history online database, I noticed that one other Oaxaca study area *núcleo* had had some of its territory expropriated by SEMARNAT, the federal agency which directs protected area management and enforcement. This partially Chinantec-speaking *ejido*, Caracol Estrella, is located where the Río Usila enters the Papalopan Commission's Miguel de la Madrid Reservoir.

7.4.1 Results using INEGI "springs" dataset

The grouped subsets of tenure categories (e.g., "social property," or "PROCEDE-surveyed *núcleos*") appear in the three tables which show all tenure categories (7.3, 7.5, and 7.4), and the most important subsets are also presented in separate tables (7.7 and 7.8). There are two reasons for this. First, the all-inclusive tenure area category totals used for tables 7.3, 7.5, and 7.4 necessarily distort the relative values within grouped subsets. Second, direct comparison with the

[109] Additionally, the huge Sierra Gorda Biosphere Reserve borders the Huasteca geodata analysis area. It covers over one third of Querétaro state (de la Maza Elvira et al. 1998, 87).

Table 7.3. Oaxaca and Huasteca geodata analysis areas combined: Observed number of INEGI-mapped springs in each tenure category, as difference from expected value; normalized to n=100 (n=123; total area is 10,208 sq km). More specific categories are grouped into more general categories adjacent to them (see page 89).

<table>
<tr><td rowspan="8">social property
+7.6</td><td colspan="4">de facto social property,
status as *núcleo* unresolved **+3.8**</td></tr>
<tr><td colspan="4">*núcleos* without PROCEDE survey **-6.6**</td></tr>
<tr><td rowspan="6">PROCEDE-surveyed
núcleos
+10.4</td><td colspan="2">only *núcleo*
perimeter surveyed **-5.9**</td><td rowspan="3">common use areas
-7.9</td></tr>
<tr><td colspan="2">common use areas
in *comunidades* **-0.2**</td></tr>
<tr><td colspan="2">common use areas
in *ejidos* **-1.8**</td></tr>
<tr><td colspan="3">human settlement areas **+8.8**</td></tr>
<tr><td rowspan="2">parceled areas
+9.5</td><td colspan="2">parceled areas in
comunidades **+1.1**</td></tr>
<tr><td colspan="2">parceled areas
in *ejidos* **+8.4**</td></tr>
<tr><td colspan="5">non-social property **-7.6**</td></tr>
</table>

PRM data would otherwise be difficult, because the PRM is drawn only from social property areas.

After normalizing to n=100, 7.2 more springs were found on social property than expected (Table 7.3), when combining both study areas. This suggests that important water sources are disproportionately located on social property, lending some support to general theme expressed by Toledo (1996) and other scholars regarding potentially high ecological impact of PROCEDE. I reiterate that this is probably mainly due to a third factor which likely correlates positively with both variables: mountainous, rugged regions tend to be associated with important springs as well as with social property, much of which is found in relatively less accessible locations, often with poorer than average soils. However, springs in limestone-dominant

Table 7.4. Sierra Norte de Oaxaca geodata analysis area: Observed number of INEGI-mapped springs in each tenure category, as difference from expected value; normalized to n=100 (n=50; total area is 6,939 sq km).

<table>
<tr><td rowspan="8">social property +7.2</td><td colspan="4">de facto social property, status as núcleo unresolved +6.5</td></tr>
<tr><td colspan="4">núcleos without PROCEDE survey +0.7</td></tr>
<tr><td rowspan="6">PROCEDE-surveyed núcleos +0.1</td><td colspan="2">only núcleo perimeter surveyed +7.4</td><td rowspan="3">common use areas +2.7</td></tr>
<tr><td colspan="2">common use areas in comunidades -0.3</td></tr>
<tr><td colspan="2">common use areas in ejidos -4.4</td></tr>
<tr><td colspan="3">human settlement areas +1.5</td></tr>
<tr><td rowspan="2">parceled areas -4.1</td><td colspan="2">parceled areas in comunidades -1.0</td></tr>
<tr><td colspan="2">parceled areas in ejidos -3.1</td></tr>
<tr><td colspan="5">non-social property -7.1</td></tr>
</table>

geological regions are disproportionately located near where these mountainous areas adjoin valleys, and therefore there is some tendency for them to be found *near* private (or at least PROCEDE-parceled) property, even if they are within social property.

Table 7.5. Huasteca Potosina geodata analysis area: Observed number of INEGI-mapped springs in each tenure category, as difference from expected value; normalized to n=100 (n=73; total area is 3,268 sq km).

<table>
<tr><td rowspan="8">social property
+18.3</td><td colspan="4">de facto social property,
status as *núcleo* unresolved **+2.6**</td></tr>
<tr><td colspan="4">*núcleos* without PROCEDE survey **+0.7**</td></tr>
<tr><td rowspan="6">PROCEDE-surveyed *núcleos*
+15.0</td><td colspan="2">only *núcleo* perimeter surveyed **+1.0**</td><td rowspan="3">common use areas
-0.2</td></tr>
<tr><td colspan="2">common use areas in *comunidades* **-1.4**</td></tr>
<tr><td colspan="2">common use areas in *ejidos* **+0.2**</td></tr>
<tr><td colspan="3">human settlement areas **+13.3**</td></tr>
<tr><td rowspan="2">parceled areas
+1.9</td><td colspan="2">parceled areas in *comunidades* **+0.8**</td></tr>
<tr><td colspan="2">parceled areas in *ejidos* **+1.1**</td></tr>
<tr><td colspan="5">non-social property **-18.4**</td></tr>
</table>

Table 7.6 isolates the portion of the Huasteca study area in non-social property, to show the observed differences between private property and *zonas federales.* I did not include the Oaxaca study area, because its non-social portion is relatively small, and the distribution of specific non-social categories in Oaxaca is less certain. This table expresses the relationships with INEGI-mapped springs as percentages rather than as normalized numbers of springs, because the sample size is so small. The results suggest that, within non-social property categories, the observed distribution of springs is about what would be expected if the distribution were even.

Table 7.6. Non-social tenure portion of Huasteca Potosina geodata analysis area: Observed percentage of INEGI-mapped springs in each tenure category, as difference from expected value (n=10; total area is 1,021 sq km).

	% of land area	**% of major springs**
private property	83	90 (70 definitely, 20 probably)
federal zones (mostly "leftover" areas in irrigation districts; smaller subcategories include large rivers and highways, and parastatal lands)	16	10
other (including unknown)	1	0

Within the social property "universe" (Table 7.7), substantially fewer springs than expected were observed in three of the four types of de jure common use areas: PROCEDE-surveyed common use areas in *ejidos* (-2.4), *núcleos* with only their perimeters surveyed by PROCEDE (-9.4), and those where PROCEDE did no work (-9.9). In contrast, both PROCEDE-surveyed parceled areas in *ejidos* (+7.8) and PROCEDE-surveyed human settlement areas (+9.6) contained substantially more springs than expected.

The relative paucity of springs in PROCEDE-certified common use areas was probably due to the bias in the data set toward the kinds of individually-oriented human uses which are generally in non-forested areas, a bias reinforced by the fact that some villages were founded at their present locations precisely because of the presence of springs. Indeed, the bias toward including springs in or near population centers is even stronger than this table suggests; many of the springs assigned to parceled areas were actually very close to the outer boundaries of human settlements. This sampling bias is instructive in how it reminds us that human values pervade human geography (particularly when it involves land tenure), but it does run the risk of failing to adequately include springs that are important to people but located under forest canopies, such as those near the stream uptakes for Talea's potable water system, or the springs of the Cerro de Tabaa over which Talea has suffered violent skirmishes with a neighboring *núcleo*.

Table 7.7 does show that, despite this likely bias in the data, important springs in *comunidades* (as opposed to *ejidos*) are located in common use areas as often as would be expected were they distributed evenly. We may speculate that this over-representation (given the bias) of springs in common use areas reflects some instances of *comunidades* actively favoring keeping their important springs in common use areas. However, we must be cautious in making any such assumptions, because the figures are based on a rather small sample. Furthermore, that sample is skewed by the fact that most of the technically PROCEDE-parceled *comunidades* in the study areas do not follow the standard PROCEDE template exemplified by Talea, but rather they follow the "inverted" innovation, typified by Cuatlamayán, of "legally common use

Table 7.7. Social property portions of the Oaxaca and Huasteca geodata analysis areas combined: Observed number of INEGI-mapped springs in each tenure category, as difference from expected value; normalized to n=100 (n=112; total area is 8,524 sq km).

<table>
<tr><td colspan="4">de facto social property,
status as núcleo unresolved +3.7</td></tr>
<tr><td colspan="4">núcleos without PROCEDE survey -9.9</td></tr>
<tr><td rowspan="6">PROCEDE-
surveyed
núcleos
+6.1</td><td colspan="2">only núcleo
perimeter surveyed -9.4</td><td rowspan="3">common
use areas
-12.2</td></tr>
<tr><td colspan="2">common use areas
in comunidades -0.4</td></tr>
<tr><td colspan="2">common use areas
in ejidos -2.4</td></tr>
<tr><td colspan="3">human settlement areas +9.6</td></tr>
<tr><td rowspan="2">parceled
areas
+8.7</td><td colspan="2">parceled areas in
comunidades +0.9</td></tr>
<tr><td colspan="2">parceled areas
in ejidos +7.8</td></tr>
</table>

area with individual farms, plus a few legally individual, but 'civic,' parcels." If indeed there is some tendency for special effort to be made in PROCEDE-parceled *comunidades* (but not in *ejidos*) to keep major springs in common use areas, this might be considered ironic, because under current law individual PROCEDE parcels in *comunidades* are actually protected from full privatization, unlike PROCEDE parcels in *ejidos*.

In Table 7.7, we see that fewer springs found than expected in *núcleos* without a PROCEDE survey. This figure is based on a small sample size, but we might speculate that such *núcleos* tend to have a history of limited interaction with the state, and that this tradition is based partly in their tendency to be located in places with relatively less physical access to the urban, "modern" parts of Mexico. Such places tend to correlate positively with large forested areas, which would reinforce the bias stemming from the INEGI methodology.

In contrast, more springs were found than expected in territories with "unresolved status" as social property *núcleos*. This may simply be a chance artifact of the data set, as Tampate and Tamapatz are huge Teenek-speaking territories in the Huasteca study area which happen to be de facto, uncertain-status *núcleos* that contain many INEGI-mapped springs. However, the result may not be entirely accidental. The uncertain-status Chinantec-speaking *núcleos* of the Usila valley in the Oaxaca study area, documented by de Teresa (1999), also contain an unusual concentration of INEGI-mapped springs. There may be a tendency for the state to "drag its feet" when it comes to legally acknowledging the village-oriented social property status of places rich in the kinds of natural resources (e.g., water) which are seen as belonging to the nation as a whole. A less charitable theory would be that this foot dragging has less to do with avoidance of ceding power from the nation to the village, and is more about maintaining such places in a condition more conducive to rapid individualized, privatized commercial development.

Table 7.8 focuses on just the land tenure categories within *núcleos* that contain individual parcels surveyed and certified by PROCEDE. Absent a more complete and verified coverage of purely de facto land tenure distinctions, this dataset gives us the best chance, if we can overcome the human-activity-oriented bias in the data, of identifying possible evidence of important springs being specifically "protected" by keeping them in common use areas.

Table 7.8. *Núcleos* with PROCEDE-surveyed parcels in the Oaxaca and Huasteca geodata analysis areas combined: Observed number of INEGI-mapped springs in each tenure category, as difference from expected value; normalized to n=100 (n=35; total area is 2,152 sq km). Human settlement areas are not included. All springs are located in the Huasteca study area.

<table>
<tr><td rowspan="4">PROCEDE-surveyed núcleos with parcels</td><td colspan="2">common use areas in comunidades -2.2</td><td rowspan="2">common use areas -13.8</td></tr>
<tr><td colspan="2">common use areas in ejidos -11.6</td></tr>
<tr><td rowspan="2">parceled areas +13.7</td><td colspan="2">parceled areas in comunidades +1.0</td></tr>
<tr><td colspan="2">parceled areas in ejidos +12.7</td></tr>
</table>

The results show that, in *núcleos* with PROCEDE parcels, especially in *ejidos*, springs are found less frequently than expected in de jure common use areas. It is difficult to remove the human-use-oriented bias here, but in any case there is no evidence from this data set of special efforts being made to include springs in PROCEDE-surveyed common use areas. Indeed, many PROCEDE-parceled *núcleos* have no de jure common use areas at all.

I reiterate the caveat that the data set for this sample is small. Of the 35 INEGI-mapped springs in PROCEDE-parceled *núcleos*, only four springs are in common use areas. These springs are not clustered, so it is unlikely that they represent a localized practice (as, for example, the "inverted" PROCEDE template seen in Cuatlamayán does represent). I have discussed two of these instances, the *ejidos* of Tanlacu and Matlapa Mestizos (subsection 7.2.2). The other two occurrences of INEGI-mapped springs in PROCEDE-surveyed common use areas are also in the Huasteca study area. Atlamaxatl is an *ejido* with 900 Nahuatl-speaking inhabitants. One third of its territory was parceled by PROCEDE with the left kept in common use, including the spring visible 7 km northwest of Tamazunchale in Figure 7.2 (page 305). The final instance is in the Nahua *comunidad* of Coaxinquila. However, this *núcleo* is one of those which, like nearby

Cuatlamayán, "inverted" the PROCEDE template, so its INEGI-mapped spring is probably within an area that is, in practice, individually parceled.

We must keep in mind that this analysis does not capture PROCEDE-surveyed "civic parcels," effectively common use parcels within individually parceled areas. If we are correct in our interpretation that springs are not, in general, a major consideration when a *núcleo* creates its common use area through PROCEDE, civic parcels (and civic *solares*) are all the more important for keeping water sources in de jure community control.[110]

With the verified data that I did acquire, we can begin to estimate the incidence of water source civic parcels in two ways:

1. 12 of the 33 RAN document study *núcleos* had individual parcels surveyed by PROCEDE. Of these twelve, five (42 percent) have at least one civic parcel dedicated to a water source. (Here, I am using "water source" to include items such as La Pila's check dam pond and Chicomezúchil's stream access point, but not storage tanks).

2. Five of the fifteen PRM *núcleos* had individual parcels surveyed by PROCEDE. Of the 42 important springs mapped through PRM within their de jure parceled areas, eight (19 percent) are located in civic parcels.

The first figure suggests that an impressively large minority of PROCEDE-parceled *núcleos* have at least one civic parcel dedicated to water sources. The second number suggests, however, that the majority of springs deemed important to communities are located on parcels assigned to individuals. Furthermore, we should not consider civic parcels, as they are currently configured within the legal system, as necessarily always representing an ideal solution to the problem of village-oriented water features within otherwise individually-parceled areas. José Ledezma Barragán, head of the RAN office in San Luis Potosí, mentioned to me the example of El Platanito y sus Anexos, an *ejido* 10 km beyond the northern boundary of the Huasteca study area. The *núcleo* had its 990-ha parceled area, and 220-ha common use area, surveyed by

[110] I have described the case of El Cristiano y sus Anexos (section 7.3), a PROCEDE-parceled *núcleo* with four INEGI-mapped springs in its parceled area (in fact, it has no PROCEDE-certified common use areas). I pointed out how, using the GAIA online coverage alone, one could almost determine that two of these springs are located in civic parcels, but without inspecting the PROCEDE documents by visiting the state RAN office, it is impossible to be sure of this.

PROCEDE in 1995. The parceled area includes many parcels along the banks of the Río Valles, at the point where the river emerges from the whitewater cascades called the Micos Falls. Tourism opportunities are being exploited both by individual *ejido* members and by the *ejido* as a whole. One parcel is dedicated to the *ejido* as a "civic parcel," but its exact purpose is not specified in the PROCEDE documents, something which Ledezma asserted might cause problems within the *ejido* in the future (interview with Ledezma Barragán 2009).

7.4.2 Results using México Indígena and CAPLAC "springs" datasets

The results in this subsection include springs declared through PRM to be important by villagers themselves, rather than the government agency INEGI.

Table 7.9. Fourteen *núcleos* in the Huasteca and Oaxaca analysis areas: Observed number of PRM-derived springs in each tenure category, as difference from expected value; normalized to n=100 (n=138; total area is 266 sq km). Human settlement areas are not included.

<table>
<tr><td colspan="4">de facto social property,
status as núcleo unresolved N.A.</td></tr>
<tr><td colspan="4">núcleos without PROCEDE survey -11.8</td></tr>
<tr><td rowspan="6">PROCEDE-
surveyed
núcleos
+11.8</td><td colspan="2">only núcleo
perimeter surveyed -14.7</td><td rowspan="3">common
use areas
-18.1</td></tr>
<tr><td colspan="2">common use areas
in comunidades N.A.</td></tr>
<tr><td colspan="2">common use areas
in ejidos -3.4</td></tr>
<tr><td colspan="3">human settlement areas +10.0</td></tr>
<tr><td rowspan="2">parceled
areas
+19.9</td><td colspan="2">parceled areas in
comunidades N.A.</td></tr>
<tr><td colspan="2">parceled areas
in ejidos +19.9</td></tr>
</table>

Table 7.10. Five *núcleos* with PROCEDE-surveyed parcels in the Huasteca: Observed number of PRM-derived springs in each tenure category, as difference from expected value; normalized to n=100 (n=45; total area is 43 sq km).

<table>
<tr><td rowspan="4">PROCEDE-surveyed núcleos with parcels</td><td colspan="2">common use areas in comunidades N.A.</td><td rowspan="2">common use areas -28.2</td></tr>
<tr><td colspan="2">common use areas in ejidos -28.2</td></tr>
<tr><td rowspan="2">parceled areas +28.2</td><td colspan="2">parceled areas in comunidades N.A.</td></tr>
<tr><td colspan="2">parceled areas in ejidos +28.2</td></tr>
</table>

To facilitate comparisons, I employed the same methods and table formats for this dataset as I did for the INEGI one. For example, civic parcels are subsumed within the land tenure class "parceled areas." The data presented in this subsection derives from 14 *núcleos*. Although it was a PRM community, I did not include Talea in this analysis, because the fieldwork there was more specifically focused on water and therefore its data may not be directly comparable to the others.

Despite the differences in the datasets, the PRM results are remarkably similar to those from the INEGI data. The tables which include all social property categories, Table 7.7 and Table 7.9, are especially close. "*Núcleos* with PROCEDE-surveyed parceled areas" have more mapped springs than would be expected were the springs evenly distributed, while both "PROCEDE-perimeter-only" *núcleos* and "non-PROCEDE" *núcleos* have fewer springs than expected. We may be tempted to posit that there is something about the presence of water sources which relates, either directly or through a common third variable, to a community's decision to have PROCEDE survey its parcels. One possibility would be that water-rich villages are more likely to have experienced commercially-oriented agriculture, and that this experience sets the stage for more individually-oriented land tenure decisions, or that it predisposes a village to cooperation with state-driven initiatives.

We must also consider the possibility that the PRM data has the same bias as the INEGI data in favor of springs located within areas of intense human use: agricultural parcels and population centers. This could cause the "PROCEDE-parceled *núcleos*" springs density to be high, simply because the *núcleos* with PROCEDE parcels tend to have smaller than average areas, but average populations. These *ejidos* and *comunidades* thus have smaller areas which are distant from intense human activities; i.e., smaller areas where fewer springs tend to be included in participatory maps, because they are less intensively present in the cognitive maps of village residents. (There are, of course, many exceptions to this general observation. Many *núcleos* include on their participatory maps a few springs far from intense human activities where certain sacred rituals take place, or are remembered to have taken place in the past).

A comparison of the tables which focus on the more restricted "universe" of PROCEDE-parceled *núcleos*, Tables 6.6 and 6.8, reinforces this interpretation. The high incidence of important springs within the parceled areas of these communities is even more apparent when using the participatory data set. While there are some springs in forested areas, unmapped by INEGI but deemed important to the community and included in their common use areas, their number is overwhelmed by the many important springs within parceled areas, to an even greater degree than shown in the INEGI data.

This observation is further reinforced when we focus the "universe" of two *núcleos* whose de facto land tenure zones we know best: Yagila and Tiltepec (Table 7.11). In this table, for which population centers are excluded, we see that there were about 40 more important springs than "expected" (after normalizing) within the agricultural parcels.[111]

The participatory research mapping process ensured that only springs deemed important to the community as a whole, or at least to a large subset of residents, would be included in the maps. As I described in detail when discussing Yagila, Tiltepec, and Talea (chapter 6), most or of these springs are considered as belonging to the community, at least in the sense that their water is accessible to anyone who wants to use it. The fact that only 19 percent of them are located within civic parcels may be a cause for alarm, *if* the act of individual parcel certification

[111] When the de facto human settlement areas are included, the values for this dataset (n=37) become: Common use areas: -54.1; Parceled areas: +20.3; Human settlement areas: +34.1.

by PROCEDE often represents a step toward individuals limiting access by others to their parcels. To the extent that this is so, PROCEDE parceling would be part of a more general disintegration of village-oriented culture as we know it.

Table 7.11. Two *núcleos* without PROCEDE parcels in Oaxaca: Observed number of PRM-derived springs in each tenure category, as difference from expected value; normalized to n=100 (n=24; total area is 86 sq km). Human settlement areas are not included.

only *núcleo* perimeter surveyed	de facto common use areas **-40.4**
	de facto parceled areas **+40.4**

The most obvious cases of PROCEDE accelerating the loss of village-oriented practices occur when a de facto common use area (including any springs within it) is divided into individual parcels at the time of PROCEDE surveying. I was involved in participatory mapping work in six *núcleos* which had PROCEDE survey their individual parcels, excluding Cuatlamayán's "inverted" scheme. Of these six, only one, Chimalaco, provided clear evidence of having significantly reduced its de facto common use area through PROCEDE. However, the regional and national figures may be much higher than suggested by this small sample. Mexican geographer Gerardo Hernández Cendejas (2008) completed fieldwork and geodata analysis in six *ejidos* within the Huasteca, and discovered that three of them had divided most or all of their forested common use areas during PROCEDE work. In Figure 7.2 (page 305), these *núcleos* occupy the ring of *ejido* land surrounding the private property area in the corner of the study area to the northwest of Tanquián.

The evidence in this and previous chapters suggests that the challenge facing many communities is not that the surface area of their common use zones diminishes through

PROCEDE, but rather that the village-oriented practices within the parceled areas might change more quickly than they would have otherwise, once the state has given its legal imprimatur to the individual parcels.

7.4.3 Indigeneity, land tenure, and water sources

As a final exercise within the same geodata analysis areas, I introduced a third variable, "indigeneity," and compared it first to land tenure, and then to INEGI-mapped springs. The land tenure results (Figures 7.3, 7.4, and 7.5) are expressed as proportions of surface areas, while the springs results (Tables 7.12, 7.13, and 7.14), for which I used same analytical approach as the rest of the geodata analysis, are expressed as expected and observed percentages.

For the indigeneity values, I used the same coverages (indigenous, mixed, non-indigenous, and no population) developed for the study area maps in chapter 2 (see section 4.5 for methods), and added the small portion of Veracruz state that is within the Oaxaca study area but omitted from the depictions of indigeneity in those maps. Like the rest of the geodata analysis in this study, I considered only surface areas, not populations. I reiterate that, in this context, "no population" does not imply "unoccupied," nor "unused by any local resident," nor "not owned by any person or *núcleo*," but simply means "far from a population center or permanent homes."[112]

Because the indigeneity polygons represent imprecise regions, I restricted the land tenure classes to four broad categories: 1. *zonas federales* (see section 3.4); 2. private property; 3. social property that is mostly de jure individual parcels (i.e., *ejidos* or *comunidades* with PROCEDE parcels but which lack large common use areas); and 4. social property that is mostly de jure common use (i.e., *ejidos* or *comunidades* with a few PROCEDE parcels and large common use areas, or with just perimeters surveyed by PROCEDE, or not surveyed by PROCEDE at all). Excluded for the analysis were the categories "de facto *núcleos*, unresolved status," "urban," and "unknown."

[112] For a population-based analysis of indigenous and land tenure in the Huasteca Potosina, see Kelly et al. 2010.

Figure 7.3: Oaxaca geodata analysis area: Proportional distribution of land tenure categories (by area) within indigenous language class areas.

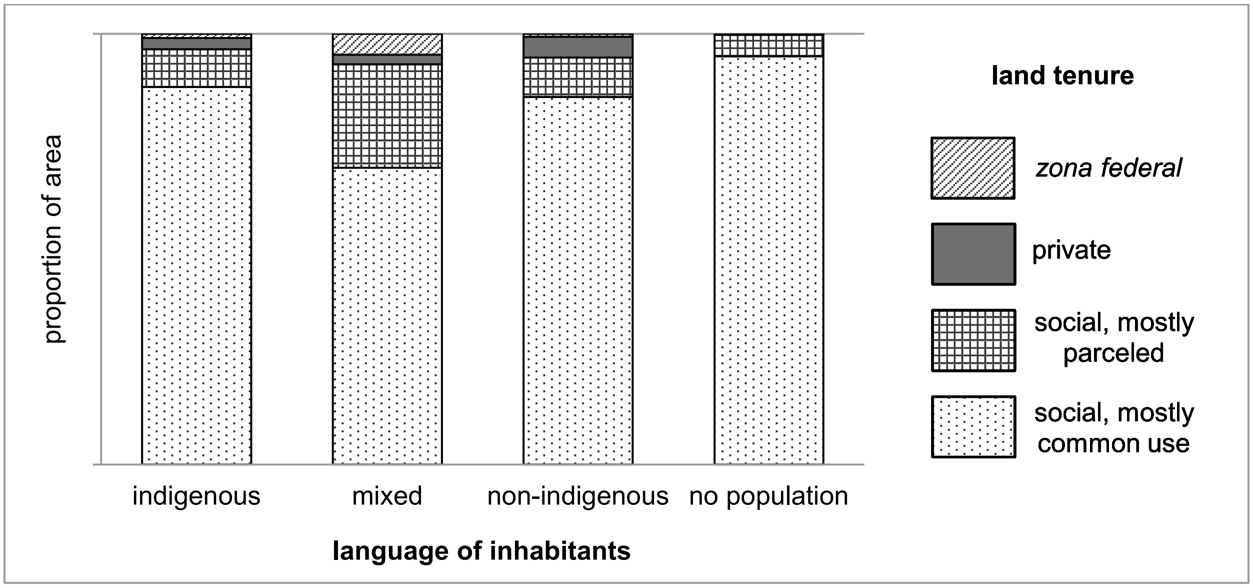


Figure 7.4: Huasteca geodata analysis area: Proportional distribution of land tenure categories (by area) within indigenous language class areas.

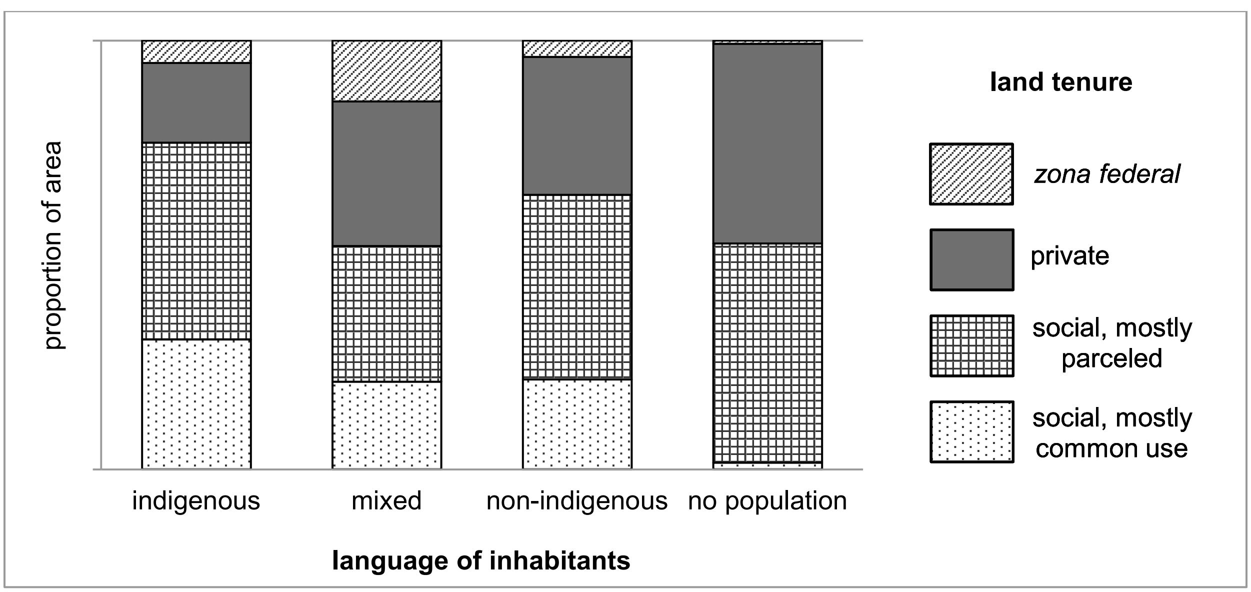
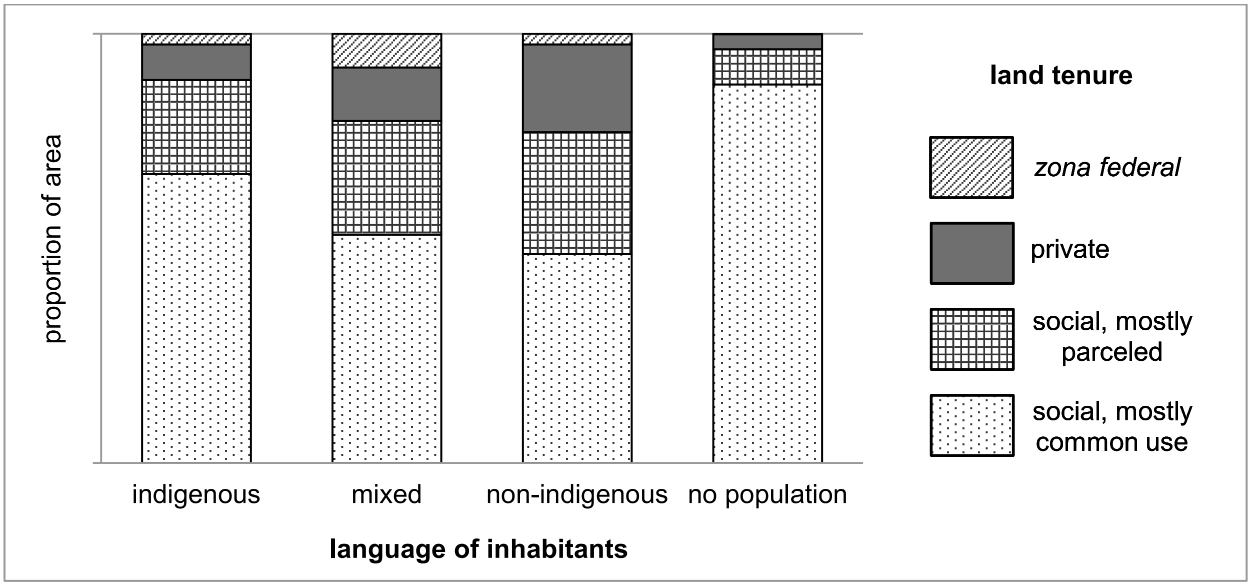


Figure 7.5: Both geodata analysis areas combined: Proportional distribution of land tenure categories (by area) within indigenous language class areas.



The most obvious and unsurprising observation is that areas dominated by indigenous language speakers correspond to the highest proportions of social properties that are mainly in de jure common use. However, the proportion of common use social property is not *overwhelmingly* greater than that found in non-indigenous language areas. *Mestizo* areas tend to have only slightly more individually-PROCEDE-parceled social property than indigenous areas; "keeping social property in de jure common use" is not a major strategy for maintaining a distinct indigenous identity, but simply one tool among many (see Kelly et al. 2010 and Liffman 2011). The main difference is with private property, of which there is little in indigenous-language-speaking areas.

In both the Oaxaca and Huasteca study areas, the *zonas federales* are dominated by mixed-language settlements. This is likely due mainly to these areas generally having been resettled since about 1950 with residents from other villages, regions, and even other states, often in connection with government-initiated irrigation projects.

The most evident difference between the two study areas is the very high proportion of common use social property in the Oaxaca area, in all language categories. However, this is partly a function of the arbitrary boundaries of the study areas. A more valid observation is that, within Oaxaca, the highest proportion of PROCEDE-parceled social property is not within the non-indigenous areas, but rather within the mixed-language areas. Even this result may be somewhat misleading: much of the "non-indigenous" zone within the Sierra Norte de Oaxaca is in fact "indigenous" in several important ways *except* in terms of language. A principal region of "non-Zapotec-speaking Zapotecs" is an area extending southward from the town of Ixtlán almost to the city of Oaxaca (Figure 2.6 on page 59).

The "no population" areas are predominantly in common use social property, the great majority within the Oaxaca study area. The Huasteca study area includes only a few, relatively small uninhabited zones, such as the area around a rugged stretch of the Río Santa María, visible in Figure 2.3 on page 51. This area is divided among private properties and parceled *ejidos*, with a few scattered, non-indigenous "*ranchos*" (isolated farmsteads) toward the mixed-language *núcleo* of Tanlacu to its west (see subsection 7.2.2).

The quantitative analysis of density of water sources in the indigenous-language, mixed, non-indigenous-language, and no population portions of the study areas (Tables 7.12, 7.13, and 7.14) is a modest exercise within the theme of much larger efforts to document the place-based links between indigenous peoples and natural resources such as forests and water in the tropical Americas (e.g., National Geographic Society 1992; National Geographic Society and Center for the Support of Native Lands 2003).

Table 7.12. Sierra Norte de Oaxaca geodata analysis area: Observed distribution of springs in INEGI 1:50,000-scale maps within indigenous language class areas, compared to expected distribution.

	expected % of springs	observed % of springs
indigenous	**47**	**63**
mixed	14	14
non-indigenous	11	12
no population	**28**	**12**

Table 7.13. Huasteca Potosina geodata analysis area: Observed distribution of springs in INEGI 1:50,000-scale maps within indigenous language class areas, compared to expected distribution.

	expected % of springs	observed % of springs
indigenous	52	55
mixed	15	15
non-indigenous	33	30
no population	4	0

Table 7.14. Oaxaca and Huasteca analysis areas combined: Observed distribution of springs in INEGI 1:50,000-scale maps within indigenous language class areas, compared to expected distribution.

	expected % of springs	observed % of springs
indigenous	48	58
mixed	14	15
non-indigenous	19	23
no population	**20**	**5**

The results show that the pattern of INEGI-mapped springs conforms to the pattern expected were they evenly distributed across space, for most language categories. There are two exceptions. First, in the Oaxaca study area, areas inhabited by indigenous language speakers have a substantially denser concentration of springs. Second, in both study areas, “no population” areas contain fewer springs than expected. While the second result is probably due to the human-activity bias in the springs data set, the first result, the overrepresentation of important springs among indigenous residents in Oaxaca (but only negligibly in the Huasteca) may reinforce the contention of some scholars (e.g., Toledo 1996) that indigenous peoples of Mexico are blessed with a disproportionate share of some of the country’s natural resources.

At least in the case of water in the two regions of the present study, it is clear that this finding is not because of some inherent indigenous capacity to maintain the existence of important springs, but rather because of physiography. For historical reasons related to patterns of commercially viable lowland and valley agriculture, and to the reach of the state and of *mestizo* culture through communication and transportation links, indigenous language speakers tend to persist in the more mountainous parts of both study regions (though there are numerous exceptions to this pattern). For geological reasons, the higher, less accessible parts of the Sierra Norte de Oaxaca are where most of the regionally important springs are located, many of them near where tributary streams of major rivers first begin to form. In the more broadly karstic Huasteca Potosina, in contrast, most of the regionally important springs are located closer to the Sierra's boundary with the Gulf Coastal Plain; these springs are actually points of *re*-emergence for rivers whose high-altitude tributary streams lie much further inland.

The following section introduces a data set that presents a more direct glimpse into the nexus of water and communities as envisioned by the state: CONAGUA water rights concessions.

7.5 CONAGUA's presence in the study areas

The 1992 Water Law required that the federal government, through CONAGUA, standardize the previously existing water rights concession systems into a single nationwide registry, the *Registro Público de Derechos de Agua* (REPDA), bringing together private and social properties into a seamless whole. CONAGUA created an internal GIS system called SIGA, drawing from their database called GEOAGUA, to model Mexico's hydrological and human geographies. From this they devised two schemes: rules about how much water would be concessioned for each certificate granted, and a schedule of fees for the concessions.

The rules about per capita volume of water use allowed by each concession are based on regionally averaged levels of supply (precipitation and aquifers) and demand (especially, the higher demand in places with more intense evapotranspiration). Both study regions are in the lowest of four categories (less than 700 cu m per person per year – the highest category being over 2100 cu m), but the highest category region begins only a few km north of the Huasteca geodata analysis area (CONAGUA 2010a). Few of the highest-concession-category areas contain large indigenous territories; the two notable ones are the Otomí region of Hidalgo state (centered on town of Ixmiquilpan), and the Maya region of Yucatán state (centered on town of Sucila).

The concession fee system, intended to promote water conservation and defray some of the costs of infrastructure, creates a pay scale which is uniform within each region and for each type of use. In general, costs are higher where less water is available, including urban demand (i.e., Mexico City is in the highest-cost region, while the drier northern states are in medium-high-cost areas). Farmers do not pay anything until they exceed certain volumes of use; when they do, they pay 13 *centavos* (about 1 US cent) per cu m, in any zone. Potable water system users pay between 4 and 36 centavos, depending on the zone, and their fees are doubled if they use above 300 liters per person, per day. The Oaxaca geodata analysis area is in the lowest-cost category, and the Huasteca one is divided between this and the second-lowest-cost category (CONAGUA 2010b).

While CONAGUA maintains the centralized digital database of concessions, various state-level agencies and other federal ones are involved in assisting rural communities develop their water infrastructure, especially village-scale potable systems for population centers. One is the Comisión Estatal de Agua (CEA) of Oaxaca state, which "is more about serving water to cities, and occasional programs to help *campesinos* build wells and the like" (interview with Bernal Flores 2009). "CONAGUA does help with potable water programs, but usually indirectly, via state-level water agencies" (interview with Yáñez Morales 2009). In indigenous areas, here defined as areas where at least 40 percent of inhabitants speak an indigenous language, state-level indigenous agencies typically contribute 20 percent of the cost toward some potable water systems, through a program called PIBAI ("Basic Infrastructure Program Attending to Indigenous Peoples), with CDI (the national indigenous agency) contributing the rest (interview with Cruz Piñeda 2008). CONAGUA is primarily interested in the point of water uptake, typically a water capture tank a long a stream, while the distribution of water to houses in a population center is more of a local issue (interview with Bernal Flores 2009).

If they were to follow the letter of the law, a *núcleo* or *municipio* wishing to dig a well for a potable water system would have to apply for a concession and file and environmental impact form with the environmental affairs agency SEMARNAT, explaining how residual waters (sewage and graywater) would be dealt with (interview with Díaz Jiménez 2009). In the CONAGUA office in Xalapa, a poster advises visitors that even many water users who pay no rights fees, a category which includes most small-scale farmers, must nonetheless obtain a concession:

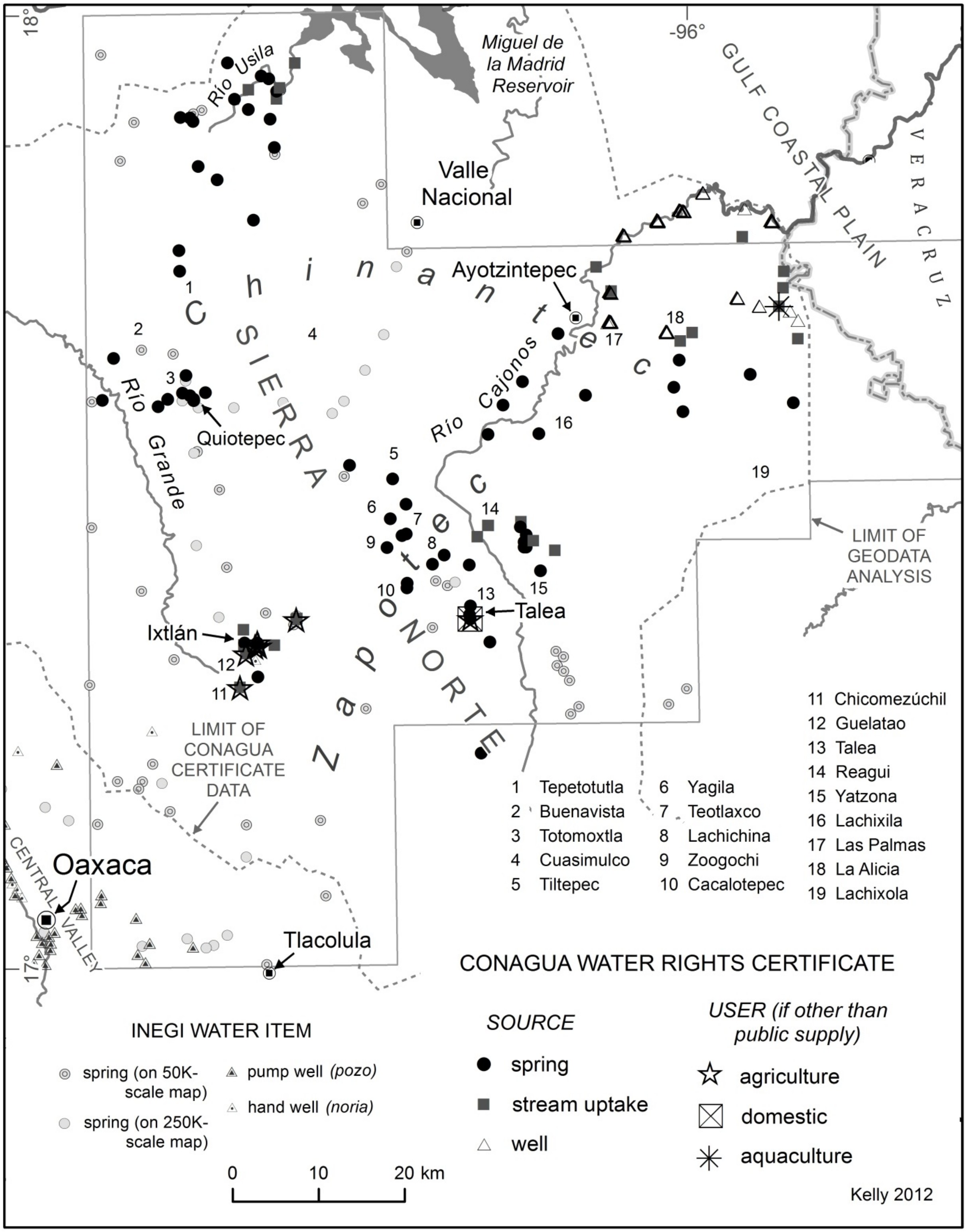
> If you use water from a river, lake, manual well [*noria*], or motorized well [*pozo*]: 1. Review the cover sheet of your Concession Title. If it expires between 2007 and 2009, apply for an extension ahead of time. 2. Go to CONAGUA with the number of your title, or a copy; and, if you pay water rights, with proof of its payment.

The Federal Rights Law specifies additional requirements, such as that "rural settlements of population up to 2,500 must install water meters [*dispositivos de medición*] at both the entrance and exit of their potable water systems" (CONAGUA 2008c, 18).

However, the strict letter of the law is only partially respected, especially in well-watered areas where the financial and technical assistance of government agencies is not as commonly sought. "It's usually the *municipios*, or councils [*patronatos*] and other associations, which ask for concessions" (interview with Yáñez Morales 2009). Within the Sierra Norte de Oaxaca study region (Figure 7.6), concessions are usually for village-scale groups or larger, as well as a for few sub-village groups. Concessions for villages in the plains tend to be for groundwater, while those for villages in the mountains, where more of the land is social property, tend to be for surface water. Despite the imperfect conformity to the laws, CONAGUA in 2006 considered the titling process nationally to be "97 percent completed" (CONAGUA 2008a, quoted in Scott, Dall'erba, and Díaz Caravantes 2010, 2). Apparently, CONAGUA is generally satisfied with the current level of concession law compliance. Perhaps it assumes that strict enforcement is unnecessary in well-watered areas, where conflicts over water rights are probably less frequent and threats to regional or national water availability are not (yet) a major issue.

The map of CONAGUA-issued active water rights concessions in the Oaxaca study area in 2009 (Figure 7.6) displays two sets of data not used for the main geodata analysis I presented

Figure 7.6. Water concessions in the Oaxaca geodata analysis area (CONAGUA 2009). Map also shows INEGI-mapped water sources (INEGI 2000; INEGI 2009) and indigenous language areas.



earlier in this chapter. The prominent dark symbols show the distribution of rural concession holders (the large town of Ayotzintepec is excluded). The light gray circles show the pattern of non-concessioned water sources, drawn from two INEGI coverages: the same 1:50,000-scale topographic "springs" data used in the geodata analysis (see Figure 7.1, on page 300), and a separate 1:250,000-scale hydrological data set.

Although a more quantitative analysis must await future investigation,[113] here I will offer a few observations on the pattern of water concession titles shown in Figure 7.6. There were 329 certificates listed for the five "sub-watersheds" (Figure 7.6 does not include the entire area of all five). All but nine, or 97 percent, were granted for "urban public" potable water systems, with social property villages and/or *municipios* (and, occasionally, sub-village groups) the apparent title holders in most cases. Titles were granted to village-scale groups even when its legal status as a *núcleo* is unresolved; this occurred for several springs and stream uptakes near the Río Usila. 61 percent of the certificates are for groundwater (wells, all but one of them hand-drawn "*norias*"), the rest for surface water (springs and stream uptakes). All nine certificates granted for a use other than a potable public system were for surface-drawn water; there are seven for agriculture (including one in Talea), one for fish farming, and one (again, in Talea) for domestic use. All the surface water sources except four are in mountainous terrain, while all the wells are in the coastal plains.

Among surface water sources, "stream uptakes" are clustered in three areas: around the town-sized *comunidades* of Ixtlán and Villa Alta, near the Río Usila, and along a section of the edge of the plains near the Veracruz border. Elsewhere, "springs" are the dominant surface water source. However, the distinction between these categories is not always as clear-cut as the concession data suggests. All four of the certificates granted to Talea or Taleans are for "springs," but from my fieldwork I know that at least one of these refers to water drawn from a *toma* (uptake) several hundred meters downstream from a spring.

The spatial distribution of concessions essentially shows that each *núcleo* obtained one for the potable water supply system serving its main human settlement area, including some cases

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[113] The concession tables I received have about thirty complete attribute fields, but the "title" (i.e., grantee) column was empty. The "RFC" (Registro Federal de Contribuyentes) field of grantee tax identification codes had been filled in, and could be used during future research.

(e.g., Tiltepec) where the system is limited to serving only a portion of the population center homes. Of the 19 RAN document study communities, 11 have one or more potable supply concessions. Of these 11 *núcleos*, Las Palmas (a partly Chinantec-speaking *ejido* on the edge of the coastal plain, with PROCEDE-surveyed parcels as well as two large common use areas) received the most certificates, for 40 wells.

Two of the places with the greatest variety of types of concessions are Ixtlán (which has 11 certificates listed) and Talea (which has four). While these are typical Sierra Norte communities in terms of indigenous identity and village-scale pride, both are also known for their histories of higher-than-average degree of engagement with the state and with commercial enterprises, albeit on their "own terms." The Talea concessions for a principal source supplying the main potable system (the Río Frío uptake, with by far the largest water volume of the four); for a source supplying houses in the hamlet of Santa Gertrudis, technically a sub-village group; for a "domestic" use originating at the Arroyo Chia, which may be the "Río del Rosario" eight-member agricultural *sociedad* I described in section 6.1; and for an "agricultural" use originating at a spring called Yuguxubuel, which may be the second *sociedad* I mentioned in that section.

Perhaps the most interesting pattern displayed in Figure 7.6 is where water rights certificates have *not* been issued, despite the presence of sizable villages. The areas with a notable absence of concessions include:

1. The highly Chinantec *núcleos* of Arroyo Palomo and Palantla, about 10 km northwest of Valle Nacional. Arroyo Palomo did not undergo any PROCEDE work.

2. 11 villages between Ixtlán and Quiotepec, on both slopes of the Río Grande Valley. These *núcleos*, which include Analco and Macuiltianguis, are typical of the Sierra Norte in that PROCEDE surveyed only their perimeter boundaries.

3. Several *núcleos* in the Río Cajonos valley south and southeast of Talea, including Solaga and Yaa. This Zapotec-speaking zone bordering the Mixe language area is shown on INEGI topographic maps to be rich in springs.

Future research may reveal some trait common to these and other apparently concession-lacking areas. I am aware that the second area of these three is a zone of high out-migration; a typical near-empty street scene there is of elderly residents and young children walking amidst parked late-model cars and impressive basketball courts. Perhaps the same remittance dollars also fund potable water systems, allowing local authorities to eschew CONAGUA funds and, in doing so, avoid applying for CONAGUA water concession certificates.

To return to the main theme of the present study, the links between land and water are complex and sometimes ambiguous, even in a legal and regulatory system as well documented and streamlined as the 1992 Water Law. Within social properties, the RAN before 1992 included a land tenure category "*Accesión de Agua*" (water concession), used primarily when a state, federal, or municipal agency wished to build water infrastructure on *ejido* or *comunidad* land. After 1992, this was replaced by the "infrastructure" public rights-of-way (visible as white strips in some of the *núcleos* in Figures 5.1.1 to 5.1.9, on pages 195 to 203). Except for "a few territorially-defined water concessions for groups of *ejidatarios – sociedades* or *coderechosos*" (interview with Ledezma Barragán 2009), all water rights concessions are now defined just as volumes of water originating from some point, without direct reference to the land around them.

However, there is still potential for tension between the individual and his or her *núcleo* over water sources, and PROCEDE parcel certification may exacerbate this tension, or at least it may influence how the tension develops or is resolved. Water which flows as a stream through an individual parcel, or emerges as a spring within the parcel, or falls as rain on the parcel, is often used by the parcel's owner, but the findings I presented in chapters 5 and 6 showed that others often desire to have access to this water. I was told by the CONAGUA user services chief in Oaxaca (interview with Bernal Flores 2009) that:

> Sometimes the village wants to use water which arises in someone's parcel. Before PROCEDE, it was more common for the *núcleo* authority [*comisariado*] to just make an agreement with the individual, but now, sometimes they will formalize it by registering with us a 'usufruct concession.' To have the rights in the first place, the individual must produce documents that show that the water they had been using was just useful for their own parcel – to avoid hoarding [*acapamiento*].
>
> Legally, all water users beyond what one uses on one's own parcel originating from that parcel – e.g., any group of *ranchos* which gets its water from another's parcel – should apply for and be granted concessions for use of national waters. In practice, though, few do; instead, they rely on *usos y costumbres*. This applies equally to villages which had PROCEDE certify individual parcels, and those that didn't.

> As populations grow, this may cause problems in a few villages which are located near large towns or cities.

The 1992 Water Law included a new section, Article 55 to address these possible tensions (CONAGUA 2008b, 76), but its approach is to favor the individual over the village. The goal is apparently to prevent bullying or corruption by a *núcleo*'s authorities or its assembly against any individual members:

> When an *ejido* or *comunidad* has parceled itself, the *ejidatarios* or *comuneros* may exploit or use the water necessary to irrigate their respective parcels.
>
> In no case may the assembly or the *ejido* authorities use, stipulate, or determine the exploitation or use of waters destined to parcels without the express consent of the *ejidatarios* who hold title[114] to those parcels, except if it regards waters indispensable for domestic needs of the human settlement.

The earlier 1972 Water Law did not refer to *ejidos* or *comunidades*, while its 1986 reform did so only to clarify that the government may decide what volume of water each *ejido* and *comunidad* has rights to as a whole (SIAPS 2010, 184). In contrast, the 120-page 1992 Water Law devotes two entire pages to *ejidos* and *comunidades*, but about three-quarters of this text concerns individual protections, not village-scale concerns. Besides the article quoted above, the law specifies how, when one or more parcels are passed to *dominio pleno* (full title), the *núcleo* must inform CONAGUA of its now-reduced land area, so its collective water rights concession may be reduced accordingly. Another article clarifies that an individual *ejidatario* or *comunero* can transfer their water rights when they transfer the title of their parcel, e.g. to another *ejidatario*.

To accompany the Water Law, an 80-page book of rules was passed in 1994, detailing what must take place to build and maintain the comprehensive and uniform concession system. Again, the only rules I could find that are specific to *ejidos* and *comunidades* refer to individual parcel matters, such as what happens to water rights when a parcel passes to *dominio pleno* (CONAGUA 2008b, 161).

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[114] I assume the phrase "hold title to" in this context does not refer to literal "titles" (*dominio pleno*), but to PROCEDE parcel certificates and any locally issued non-PROCEDE de facto parcel documents.

When México Indígena student researchers Gerardo López Roque and Jacinto Jiménez asked the *comuneros* of Cuatlamayán about water, they were told that “four years ago, some people from the *municipio* came to them and told them that everyone who had *pozos* [shallow wells, often modified natural springs] in their [de facto] parcel had to register them, since any water from more than 80 cm deep is national water, and so they’d have to pay a tax” – i.e., that they would have to apply for individual concessions for agricultural use of groundwater, in addition to any potable-use water concession whose costs are shared across the entire *núcleo*. In the Oaxaca CONAGUA office, I overheard two indigenous men being told that, even if they just wanted to dig a shallow well in a parcel for individual use, they would need a permission form (i.e., concession application), including a sketch, description of materials, and itemized expenses (interview with Díaz Jiménez 2009).

This top-down legal focus on individual *ejidatarios* and *comuneros* conforms to the neoliberal mindset that also produced the PROCEDE initiative, but it runs counter to the intent of the Agrarian Law’s Articles 27 and 267, which even after the 1992 reforms state that “populated *núcleos* which de facto or de jure maintain their communal state will be empowered to enjoy in common the lands, forests, and waters which belong to them or which have been returned to them” (quoted in RAN 1981, 91). Perhaps the contradiction is resolved by focusing on the phrase “maintain their communal state” (“*guardan el estado communal*”). This phrase is ambiguous enough to give the government the option to exercise the “no true Scotsman fallacy,” whereby the definition of “communal state” can be molded to suit any specific situation. Who is to say whether a village is village-oriented enough to satisfy this condition?

7.5 Summary of Results

The density of INEGI-mapped springs is greater on social property than on non-social property. Among social property categories (*núcleos* with only their perimeters surveyed by PROCEDE, non-PROCEDE ones, etc.), the results were mixed, and probably reflect the fact that *núcleos* without PROCEDE-surveyed individual parcels tend to have large areas, and therefore more land far from areas of intense human activity, and thus lower overall density of springs highly valued by local residents and other people. When the more detailed PRM data is analyzed, an even greater “bias” toward springs in human activity areas was found. However, many communities, especially indigenous ones, also place high value on one or two “sacred” springs deep within their common use forested areas; examples of this include specific small natural lakes in Talea (page 253) and Nieves (page 204), and springs at caves in Tancuime and Santa Cruz. De facto or de jure “common use areas” were not found to be a method specifically employed to keep water sources in community control, but sources such as these “sacred” sites tend to be located in areas that are designated as “common use” for other reasons.

The higher density of community-valued springs in individual parceled areas was found both in *núcleos* where PROCEDE has surveyed the parceled areas and common use areas areas, and in those where PROCEDE has not done this work. Exact figures for PROCEDE-certified water source “civic” parcels are not known for the geodata analysis areas, but several lines of evidence suggest that this practice is employed in perhaps as much as 40 percent of PROCEDE-parceled *núcleos*. However, in these *ejidos* and *comunidades* only a minority of important springs are kept in de jure community control by this method. To the degree that PROCEDE parceling encourages an increase in individual orientation toward land and (to a lesser extent) toward water sources, the assigning of civic parcels represents one method to counter this trend, but even where this method is employed, whatever village-scale orientation toward water sources persists will do so more because of cultural practices and local leadership than by any purely legal mechanism.

Some relationship was found between indigeneity (defined here by language) and density of INEGI-mapped springs, but only in the Oaxaca study area. Areas with high densities of springs have specific geophysical characteristics. In the Oaxaca study region headwaters of large rivers tend to be located high in the mountains, while in the Huasteca study region springs are concentrated where large rivers re-emerge near the base of karstic ridges. This physical geography also has a strong influence on land tenure patterns: in both study regions, social property – especially, *núcleos* without PROCEDE-certified parcels – tend to be located in the mountains, while non-social property and some *núcleos* with PROCEDE-certified parcels are more common in the plains. These factors combine so that INEGI-mapped springs happen to be mainly located deep within social property areas in Oaxaca, but near the ragged boundary between social and non-social property in the Huasteca. Because “social property” – especially, *núcleos* without PROCEDE-certified parcels – is moderately correlated with "indigeneity," it is not surprising that a weak relationship between indigeneity and springs would be found in Oaxaca, and no relationship at all in the Huasteca.

At this time, the CONAGUA system of water rights concessions has limited impact in the Oaxaca study region. If anything, it may occasionally help to strengthen village orientation, as almost all the current concessions are for village-scale potable water supply installations. However, this is merely due to the low level of enforcement of regulations in the study area. Technically speaking, individual parcel-to-parcel and sub-village-group water users should apply for concessions, but because the study area rarely suffers water shortages, there is little incentive for CONAGUA, villages, or individuals to apportion water through the concession process. The groundwork for intra-village conflicts, or at least for erosion of village-scale practices, has been laid by 1992 and 2004 changes to the Water Law that emphasize "protecting" individual *ejidatarios* and *comuneros* from corrupt abusers of village-scale power, although I did not recognize many examples of such "*caciquismo*" in my participatory fieldwork experiences (although see Yetman 2000, 216 for references to evidence of corruption in some *ejidos*).

7. Conclusion

My hypothesis was that indigenous, water-rich communities in Mexico are maintaining the same degree of village-scale control of water sources that they practiced before the neoliberal land tenure reforms of the 1990s. Documents in the National Agrarian Registry (RAN) and information collected through participatory research mapping (PRM) demonstrate an impressive persistence of village-scale practices in most communities during the first fifteen years of implementation of the reforms. In some villages there are recent indications of tension regarding an individual's right to water from sources within his or her agricultural parcel, but in most cases these tensions continue to be avoided through local practices of tacit, oral, and occasionally written agreements. These generalizations apply equally to *núcleos agrarios* (village-scale units with social property tenure regimes) which have had their individual parcels surveyed and certified through the PROCEDE program or its successor FANAR and to those which have not had this work done. For those *núcleos* that wish to maintain a certain degree of village-scale orientation toward land and natural resources, PROCEDE parceling offers both opportunities and challenges. The opportunities for adjusting the state's standard template tend to be embraced in villages with strong local leadership and a history of creative engagement with the state. The challenges arise from the gradual evolution toward individual orientation which PROCEDE parceling may often accentuate, especially in conjunction with subtle changes to the national Water Law which tilt toward a tighter linkage between water sources and land ownership.

Because locally-defined "important" springs are nearly always within or close to areas of intense human activity – areas which are usually individually parceled, by law or in fact – these subtle legal changes are magnified. Few of these springs are located within de facto common use areas. In communities where PROCEDE has certified individual parcels, this pattern generally holds true. The most important exception to this is the scattered occurrence of "civic" parcels – individual parcels (*not* conventional common use areas) assigned to the *núcleo*, rather than to any one *ejidatario* or *comunero*. A minority of civic parcels were established to keep certain water sources fully in the hands of the community. They typically protect about 20 percent of the "important" water sources. It is interesting that communities that lack water-related civic parcels, either because they did not undergo PROCEDE parceling or because they did so but without implementing this adjustment, tend to maintain village-scale control over about the same 20 percent of their important water sources using other means, e.g. by agreeing in the *ejido* or *comunidad* assembly that particular water sources are "protected." The short-term effect of PROCEDE parceling is neither to trigger village-scale practices nor to suppress them, but rather to influence the precise form those practices take.

However, this cautious optimism must be tempered by two caveats, one spatial and the other temporal. The spatial caveat is that these findings only apply more or less directly to the seven areas (besides the two study areas) shown as stippled overlapping light or dark gray in Figure 1.7 on page 39. The five smaller areas are the central (Nahuatl-speaking) Huasteca region along the border of Veracruz and Hidalgo states; the Nahuatl-speaking portion of the Sierra de las Tuxtlas in southern Veracruz; the Mixe-speaking region southeast of the Oaxaca study area; and an area of Amuzgo, Triqui, and Mixtec speakers along the border of Oaxaca and Guerrero states. The two larger regions are the entire highland area of northern Chiapas state, inhabited by speakers of several languages in the Mayan family; and the large but sparsely settled Yucatec Maya-speaking central portion of Quintana Roo state and southwestern Yucatán state. The temporal caveat is that, even within these areas, only some villages will be able to maintain a high degree of village-scale practices toward land and natural resources. In other villages, the next generation of residents will cease to carry out customary, orally transmitted practices of village orientation in the face of the legal individualization of property.

A quantitative analysis of larger regions, the Sierra Norte de Oaxaca and the Huasteca Potosina, combined springs included in government-produced topographic maps with land tenure information based on a government GIS web portal and supplemented by other sources. One finding was that the geophysical situation of the Huasteca Potosina favors the clustering of large springs near the spatially complex boundary between areas that favor individual-oriented land tenure and areas that favor village-oriented land tenure, while the situation of the Sierra Norte de Oaxaca favors clustering of springs deep within village-oriented land tenure areas. As much as any cultural or historical differences between the two regions, this fact makes concerns about village-scale control of water a more urgent matter in the Huasteca Potosina.

8. Discussion

8.1.1 The village ethos

This study fundamentally concerns the ethos of the village-scale territorial unit: an individual's tendency – never absolute or exclusive, merely a tendency – to interact with others in such ways that the interests of a group of people of between about 50 and 4000 individuals are kept in mind, a group which identifies itself strongly with a particular place or territory.[115] There are many sorts of interactions among individual villagers, and between villagers (collectively or individually) and external entities. These include commercial interactions, cultural exchanges, and bodily movements (e.g., migration). The external entity that I focus on in this study is the state, which can take forms that include federal programs, enforced laws, and state-level or county-level initiatives. Because they identify themselves with ancestral communities which predated the formation of the state in particular places, indigenous communities have a special relationship of contrasts with, and accommodations to, these state-driven initiatives. Klaus Deininger and his World Bank colleagues (2001) claimed that any difference in response to PROCEDE between indigenous and *mestizo* (non-indigenous) *núcleos* has little to do with indigeneity per se, but rather is rooted in other variables which happen to imperfectly correlate with indigeneity such as relative physical isolation. This may be true: activist scholar Ana de Ita (2006, 158) makes the point that *mestizo ejidatarios* also have a special relationship with the land, because their ancestors "fought for it" during and after the Mexican Revolution. In any case, "pure indigeneity" is always a problematic concept, and applies especially poorly to Mexico. Because my study only includes non-indigenous villages in the large-area geodata analysis, not in the intensive archival and participatory communities, I cannot offer new evidence on this subject without additional research. I can merely suggest that there are probably some

[115] Biologist-mathematician Martin Nowak (2006, 1560-1562) has used computer models of natural selection to explore the advantages and conditions of cooperative practices. He found that "real populations are not well-mixed. Spatial structures or social networks imply that some individuals interact more often than others. [When we run an evolutionary graph theory model], cooperators can prevail by forming network clusters, where they help each other. The resulting 'network reciprocity' is a generalization of 'spatial reciprocity'."

differences between practices which reflect *mestizo* attachments to territory with a time depth of decades and indigenous ones based on attachments that span centuries or millennia.[116]

Village-scale orientation persists and evolves through villagers engaging with state initiatives while retaining some ambiguity and skepticism towards them.[117] In the Zapotec *comunidad* of Talea, residents recently signed up for a Payment for Environmental Services (PES) initiative, but later rejected it in disappointment. Both their initial enthusiasm and their eventual dismissal express attitudes documented in the same community by Roberto González over ten years ago, and by Laura Nader over forty years ago. In 1996, Scott Whiteford and Francisco Bernal (1996, 227) interviewed and rural residents in three regions in Mexico, revealing a similar mix of engagement and suspicion:

> In all three regions there was a high degree of skepticism about NAFTA (90 percent opposed), Article 27 [i.e., PROCEDE] (44 percent opposed), and the new water law (51 percent opposed). At the same time, the majority of campesinos felt that they did not know enough about any of the three programs. The distrust of the government emerged as the dominant reason the change was opposed, not necessarily the

[116] Some scholars emphasize that some Mexican indigenous groups, to one degree or another, actively and consciously maintain conceptual ethnic territories larger than the *núcleo*, despite the state's longtime discouraging of such regional attachments. Alicia Barabas (2004, 108) asserts that "the progressive implantation of Western notions of territoriality [. . .] for example by making maps of village lands and marking their boundaries, changed the indigenous ways of thinking about territory. [. . .] A grave consequence of the long and complex process of fragmenting and diminishing ethnoterritories is that indigenous people lost their memory of them and gradually encapsulated the notions of a people and and ethnoterritory in terms of *núcleos agrarios*." Nevertheless, there are some persistent practices, mainly related to sacred natural places such as springs or mountains or to other pilgrimage destinations, which might serve as a starting point for more formally recognized larger territories (Barabas 2004, 113-114). Paul Liffman (2000, 2) offers an even more optimistic view that, at least in the case of the Huichols and other indigenous groups in the 'Gran Nayar' region of western Mexico, "everyday people who have been carrying out territorially extensive ritual practices far beyond the limits of their *comunidades* and *ejidos* for centuries are now tying those practices into political demands as well."

[117] The village-scale community is free to make decisions about participation with academic research projects, as well as with state or NGO programs. In December 2008, the *núcleo* assemblies of Tiltepec and Yagila elected to suspend their participation in the México Indígena participatory research mapping (PRM) effort, just as the nearby *núcleo* of Yagavila had chosen to do several months before. In each case, I and my academic colleagues immediately removed any community maps from public accessibility, and destroyed any personal records or geospatial data not available through open sources. I celebrate each community's decision as a glorious example of village-scale orientation. While one might contend that some of the deeper fears expressed by certain *comuneros* at the time of these suspensions were factually unfounded, I prefer to rejoice in the declaration of indigenous territoriality and culture which is represented *both* by any village's participation in a PRM project, *and* by any village's resolution to denounce it.

> programs themselves. In fact, both Article 27 and the new water law were supported in principle, meaning people were willing to accept privatization and participatory management.

In any village, most practices concerning land tenure and natural resources blend the interests of the village and the individual.[118] Furthermore, some residents in any village are inevitably more individual-oriented than their neighbors. One might posit that the degree of engagement with the state is largely predicated on the sociopolitical character of any particular *núcleo*, which is shaped by at least three interrelated factors: its physical connectedness to cities; whether, like Talea, it has a historical *raison d'être* which encouraged a local attitude of ready admittance of outsiders; and the vigor and outlook of local leaders.[119] Broadly speaking, both the Huasteca Potosina and the Sierra Norte de Oaxaca have historical precedents of hostile attitudes toward interlopers. Both were the site of famous indigenous defeats of Spanish conquistadors. In the Huasteca in 1518, Alonso Álvarez de Pineda was killed, with many of his men, by Aztecs who were ancestors of the region's Nahuas (Morison 1974, 517). In 1522, Gonzalo de Sandoval was repulsed by Zapotecs at Tiltepec, who killed one third of his 200 soldiers (Chance 1989, 38).

8.1.2 "Collectivist" *núcleos*: a clarification

Since the inception of the social property era, the Mexican government has recognized that rural practices tend to lie along a continuum between individual and village orientation. In its occasional nationwide Ejido Censuses (which include all *núcleos*), agricultural-livestock-forestry activities are counted as being either "collective" ("*realizada en forma colectiva*") or "non-collective" in nature (INEGI 2001a, INEGI 2008). It is important to understand that "collective" only refers to a specific form of village-scale orientation: work that is performed by most or all village households formally organized for a single commercial purpose (Singelmann 1978, 57). It does not directly signify anything particular about land tenure practices, except that any collectivist *núcleo* necessarily include some land dedicated to the common commercial

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[118] The trout hatchery and recreational pool recently built by a Talean entrepreneur is a good example of a water-related individual initiative which was conceived with village-scale benefits in mind.

[119] For a dicussion of nuanced engagements with the modern state at multiple scales, see Li (2005).

purpose. The establishment of collectivist *ejidos* (almost never *comunidades agrarias*) was especially strong during the Cárdenas administration in the late 1930s (Singelmann 1978, 38). The two Ejido Censuses for which this data is readily available were conducted in 2001 and 2007. They show that, in general, about five percent of the agriculture and livestock ranching is collective, and 50 percent of the commercial forestry, but because agriculture and livestock ranching is much more common than commercial forestry, overall about 7 percent of *núcleos* have collective production of some sort (INEGI 2001a, INEGI 2008).

It is not coincidental that of my 33 RAN document study *núcleos*, the same *ejido*, Las Armas, includes the most clearly collectivist agricultural scheme (an irrigated sugar cane zone administered by a rural corporation owned equally by all *ejidatarios*) is also among the most market-oriented of the villages, and that it enthusiastically participated in PROCEDE. Las Armas is also the one *núcleo* of the 33 to definitely contain a *sociedad de producción rural* – a "rural production society" – that is, a government-recognized collectivist corporation consisting of all or some *ejidatarios* or *comuneros* for selling an agricultural product.

Between 2001 and 2007, collective agriculture increased in both relative and absolute terms: a relative increase from 4.4 percent to 5.9 percent of all *núcleos* which practice agriculture, and a surprising 40 percent increase in absolute terms, from 1,236 to 1,734 *núcleos* overall.[120] Despite their superficially "socialist" appearance, collectivist *ejidos* tend to be more capitalist, and less self-sustainable, than others because they are so much more dedicated to commercial agriculture rather than subsistence[121] (Stavenhagen 1975, 163). In some indigenous areas, such as parts of Guatemala, the practice of subsistence farming is an important part of identifying oneself, and being identified by others, as "indigenous" (Brent Metz, University of Kansas anthropologist, pers. comm., 2012). Nevertheless, Las Armas is proudly indigenous, and atypically has significant numbers of both Nahua and Teenek residents.

[120] The differences between absolute and relative figures arise from the fact that the total number of social property *núcleos* actually jumped from 30,305 in 2001 to 31,514 in 2007, presumably due mainly to the legal resolution of villages with uncertain status.

[121] When Chinantec villages were to be flooded by the Papaloapan Commission reservoirs (Barabas and Bartolomé 1973), the government chose the "collective *ejido*" as the format for the resettlements, even though most of the villagers thought this was not a workable scheme. "As one campesino said, 'the collective idea came from the government; we're used to working individually, because in collective work, the little that we earn must be shared among everyone" (de Teresa 2000, 97).

8.1.3 Legal changes and challenges in post-1992 Mexico

Rather than introducing an entirely new spatiality to a *núcleo*, PROCEDE surveying and certification tends to merely add a new level of state imprimatur over existing de facto intra-village tenure patterns. However, there are at least five important ways in which this sometimes is not the case. First, PROCEDE surveying fixes in space what was, in some instances, a positionally malleable tenure boundary. Second, PROCEDE surveying reduces the variety of actual tenure categories to a simplified system; for example, the "intermediate areas" (e.g., in the Chinantec comunidad of Totomoxtla) are one potential "casualty" of PROCEDE. Third, PROCEDE surveys are absurdly precise, with boundary vertex coordinates stated in millimeters. This produces, in some cases, sharper boundary lines than are appropriate to local tenure practices. Fourth, surprisingly often, the RAN defines a "*núcleo*" contrary to the real village identities, and this is reconfirmed through PROCEDE certification. Two of the communities investigated in this study (Cuatlamayán and Tiltepec) legally share their territory with another village that they have nothing to do with in daily life. Talea, too, is almost an example of this, because the hamlet of Santa Gertrudis within its territory takes care of most of its own affairs. Fifth, existing village-scale control over a spatially-defined *núcleo* territory is obviously directly affected when one or more individual parcels are removed from its territory through conversion to *dominio pleno*.[122] However, *dominio pleno* is still rare in most indigenous areas.

Practices which blend the individual and the village have always existed in social property communities, and they still persist and evolve. However, CONAGUA's nationally standardized rights concession system does, in theory, contribute to the village's loss of control over water sources within its boundaries. Article 55 of the 1992/2004 Water Law clarifies that the individual parcel owner has first rights to water; and, any village-scale infrastructure should be filed with the state's registry, and subject to a nationally standardized fee schedule. The village is compelled to cede power to both the individual and the state, which emphasizes the ties between

[122] Eric Perramond (2010, 78-80) found that "many private ranches are creations of former *ejido* members who now own their ranch outright. [. . .] Because the 'process' of becoming private has remained elusive in the social science literature, it has reinforced the binary of 'private' or 'communal' in land-tenure discussions. [. . .] Are they part of *ejido*, or not? Yes and no. Some maintain ties, and some other community members don't mind this. [. . .] Typically, however, the transition from communal to private involves a gentle phasing out of communal role-playing."

water sources and land only in the context of an *individual's* rights – and only as long as that individual is prepared to receive the state's blessing through a registered concession (Kauffer Michel 2006, 222).

Political scientist Michelle Diggles' doctoral dissertation comparing responses to PROCEDE in two indigenous *ejidos* in Yucatán state describes one evolving nexus between individualized land tenure and water sources. Beginning around 1970, the ejido of Maní gradually engaged with a state initative to encourage well irrigation for citrus plantations. The irrigated portions of the *núcleo* territory became de facto individual parcels, while the non-irrigated areas remained as de facto common use areas planted in rotative *milpa* (maize complex) and secondary forest. The community accepted PROCEDE parceling for its irrigated area, and kept the *milpa* zone as de jure common use (Diggles 2008, 104). PROCEDE parceling had the effect of encouraging parcel sales within the *ejido*, including among non-*ejidatarios*, but indigenous self-identity was maintained mainly through practices within the common use area (Diggles 2008, 1).

In general, an interesting and probably unintended consequence of the division of PROCEDE-surveyed *núcleos* into legally distinct individual parcels is the greater degree of state regulation on waters. Many streams and ponds now cross multiple properties which before were contained within a single property, the *ejido* or *comunidad*. The Mexican Constitution stipulates that "[. . .] water bodies or courses completely contained within a single parcel are considered an integral part of the property" (Cámara de Diputados 2004, 15). This provides one example among many that neoliberal-inspired initiatives are usually promoted as reducing the role of the state, but in fact they tend to increase it.

We must avoid overstating the degree to which individualization of water rights can ever be compared or linked to the privatization of land ownership. Karen Bakker, paraphrasing Noel Castree, has stated that geographers are "unable to generate convincing explanations of the neoliberalization of nature as a historically and geographically differentiated, yet global (or at least translocal) phenomenon." For example, some primary commodities – specifically, water – have been subject to a more "restricted" neoliberalization than certain others (Bakker 2010b, 721). A few components of the1992 and 2004 reforms to Mexico's Water Law do bring a subtle new emphasis to the linkage of land ownership and water rights, but there are three facts which would impede and ultimately limit this shift, even if it were not resisted in some social property communities. First, land ownership is never entirely "individual" or "private" (see sub-section 1.1.1). Even the most neoliberalized system recognizes the many kinds of group interests tied to any property, and to its natural resources. Second, the state has a compelling interest in keeping water fundamentally available as a public utility. This is reflected in the Mexican Constitution, in the standardizing of the CONAGUA water rights concession system, and perhaps in the state's the deliberate failure to bestow social property *núcleo* status on villages in the Miguel de la Madrid Reservoir watershed (see subsection 7.4.1). Finally, the fluid or vaporous nature of water as a physical substance limits the ways in which it can be linked to particular properties or territories.

8.1.4 "Successful" villages and water in the study regions

It has been said that the successful management of natural resources by village-scale groups depends only partly on legal decrees. More fundamentally, it is an issue of social capital (Madrid et al. 2009, 186), which should include organizational experience, shared general values, and clearly delimited resource boundaries (Merino 2004, 47). These scholars would contend that there is nothing *inherently* "anti-village" about PROCEDE, but they would concede that it is part of a larger, longer-term process of village disintegration or, occasionally, re-integration in a new form. Neoliberal land tenure reform represents yet another challenge facing all rural societies as they come into increasing contact with the state, with the global economy, with the urban centers of cultural, financial, and political power, and with each other.

The varied resistance to, and modifications of, PROCEDE can be seen as another step in the centuries-long process of forging a Mexican identity that fuses the "indigenous" with the "Western." Some have credited the initial efforts in this enterprise from the Western point of view to the Jesuits, who until their expulsion in 1767 worked more than anyone else other than the indigenous themselves to make the "Mexican territory [. . .] a shared legacy" (Alfaro 2011, 84). Nora Haenn (2006, 142) described neoliberal-era creative engagement of social property residents as "the re-appropriation of PROCEDE at the state, regional, and local levels" (Haenn).

In Talea, the invention of "customary" practices that embrace the commercial sector without abandoning the local is nothing new: "Talea's coffee tradition is a case of cultural creativity" (González 2001, 226).

Regarding water, this creative engagement with the state and with the commercial sector will be put to the test in certain places more acutely than in others. Within regions where abundant rainfall has made the development of an explicit local rights apportionment system unnecessary, a small subset of villages may nevertheless have new demands placed on their water. The two types of external water users most likely to affect a few of the villages in the Huasteca Potosina or the Sierra Norte de Oaxaca are growing cities and water-intensive commercial export crops; water-intensive rural industries may also appear in a few places. Among the RAN document study *núcleos*, the ones most likely to serve as sources for medium-scale water transport to cities are Huichimal, La Lima, and La Subida (Figure 7.2 on page 305), which are 10 to 20 km from the city of Ciudad Valles. The *ejido* or *comunidad* most likely to be called upon to provide water for large-scale commercial irrigation may be Lachixola (Figure 7.1 on page 300), which is located near an increasingly important area for export-quality mangos. However, such communities will be the exception rather than the rule: long-distance water transport is expensive and rare. In any case, as the example of Axocopa demonstrates (subsection 1.2.2), the pressure of an outside entity placing demands on a valuable resource can sometimes *improve* village orientation. In the longer term, climate change may also play a role.[123]

8.1.5 Final thoughts: Indigenous individuals in indigenous villages

It is not necessary to introduce "indigeneity" into the story of evolving practices and natural resources in social property Mexico, but it is a contributing factor to the degree and forms of resistance to erosion of village-oriented rights and obligations. Indigenous culture is positively

[123] Anecdotally, one preliminary indicator of climate change in my study areas may be the several "dried-up" springs scattered across several of the *núcleos*. For example, a local informant in Cuatlamayán told México Indígena student researchers that "before, the wells and springs usually had water all year round, the Tancanhuitz Arroyo was clean, and enough water ran so that various folks fished, and it rained a lot; the planting and the harvest is all over the place these days, and sometimes it fails altogether." Preliminary data colleceted by entomologist Hans Clebsch (pers. comm., 2007) on wasps in the Río Sayulapam valley (Fig. 2.4 on page 53) suggests the possibility of altitudinal habitat shifts in the Sierra Norte due to climate change.

correlated with both outright refusal to convert individual parcels from de facto to de jure status, and with less easily quantifiable preservation of village-oriented practices even where PROCEDE parceling has occurred. To an extent, the 1992 reforms already accommodated the distinctive culture of some indigenous areas, by not allowing newly surveyed *comunidad* parcels to be fully privatized (*dominio pleno*). (I remind the reader that nearly all *comunidades* are "indigenous" by most definitions of the word, while at most half of Mexico's *ejidos* are in some sense "indigenous.") Indeed, for some members of some *comunidades* such as Talea, PROCEDE represents an example of the state *prohibiting* certain individual ownership and commercial opportunities they desire. In other words, even under Salinas and afterwards, much of the Mexican bureaucracy has maintained an interest in preserving some elements of the Revolution-era land reforms, or at least the appearance of preserving them. While the era of progressive land redistribution is obviously long over, the PRI's recent (2012) return to national power may engender a further prolonging of some of those ideals, at least in rhetoric if not in action.

Precisely because Mexico does not officially designate or recognize individuals or territories as "indigenous," indigeneity is a pervasive, creative, active undercurrent rather than a static, segregated category. In the words of Mary Louise Pratt (2007, 403):

> The idea of generativity perhaps takes one small step past jaded pragmatism. It conceives of indigeneity not as a configuration or a state, but as a force that enables, that makes things happen. This generativity, I would suggest, lies not only in what indigeneity actually makes happen in a given instance, but also in the unrealized possibilities that it creates in every situation, and that remains as potentialities that can be activated in the future. One imagines indigeneity, then, as an unfolding in space-time that generates realized and unrealized possibilities.

Cultural ecologists must always be careful to refrain from passing judgment on demonstrations of individual agency. Any one villager is free to decide, from moment to moment, what action is best for them, and how to best utilize the structures of family, village, state, and world. In Talea, Laura Nader (1990, 260) observed that "state and village law often disagree over what is more important – the public good or the individual. Individuals [. . .] have a keen understanding of which jurisdiction is more favorable to their plight or where their situation is more negotiable." With the increasingly robust connectivity pathways afforded by the Internet and by cyclical emigration, the *world beyond the state* is an ever-increasing panoply of further options for individual engagement, what David Slater calls “globalization from below” (Slater 2004, 219; see also Warf 2012, 279).

While connectivity and opportunity should be celebrated, Peter Singelmann (1978), inspired by Ferdinand Tönnies (1957), reminded us that *something* is lost when a village and its residents forge deeper ties with national and international political and market structures. According to Singlemann, the village loses autonomy and self-dependence, and with it a predictable, steady existence, subject to neither boom nor bust. Debatably, this loss is a price worth paying: first, because global connectivity can help make a wider range of lifeways available to certain individuals, e.g., women and landless “*pobladores*”; and second, because many indigenous individuals are able to maintain a deep tie to specific territories and village-scale groups *while* they simultaneously engage in more “modern,” less place-bound practices.

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NOTE: The dagger symbol (†) indicates a pseudonym.

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