

Land cover change and ownership turnover in the agricultural frontier: the Maya Biosphere Reserve, Guatemala

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Abstract: This study investigates land cover change and land ownership turnover in an area that is both the agricultural frontier and a priority conservation zone, the Sierra del Lacandón National Park (SLNP), Petén, Guatemala. The goal is to understand how the agricultural frontier changes over time with regard to population, household characteristics, and land use. This study analyzes panel-data consisting of household interviews conducted with farmers living within the SLNP boundaries or its buffer zone in 1998 and 2009. Despite dramatic population growth, the overall trend of the area is towards the extensification of farming practices. On average, households crop larger areas of higher value crops and less maize, but these changes have not kept pace with pasture expansion. As in Latin America overall, pasture expansion is a main driver of deforestation. The area simultaneously experiences farm parcel consolidation and splintering. Half of the landowning households in 1998 sold their land by 2009; some such land was consolidated by large landholders, while other parcels became split among multiple owners. Understanding land cover changes over time and how land ownership turnover occurs is key for crafting policies aimed at slowing further forest clearing and the impoverishment of subsistence populations.

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Introduction

This study investigates land cover change and land ownership turnover in an area that is both an agricultural frontier and a priority conservation zone, the Sierra del Lacandón National Park (SLNP), Petén, Guatemala (Figure 1). The research responds to the call for integrated investigations of human development and environmental sustainability (An and López-Carr 2012; Bremner et al 2010) and for examining specifically the role of human population in tropical forest transitions (Carr 2002, López-Carr and Burgdorfer 2013). The Petén is a biodiversity hotspot (Myers, Mittermeier et al. 2000). Migration to Petén of large landholders and subsistence farmers from elsewhere in Guatemala since the 1950s has eliminated 60% this lowland area's seasonal tropical forests (Segeplan 2011). The SLNP was established in 1990 as a core conservation zone of the Maya Biosphere Reserve, with access permitted only for the purposes of research and tourism. Nonetheless, the area was already populated at the time of park establishment, and population growth via in-migration (Carr 2008) and natural growth (Sutherland et al 2004) has continued over subsequent decades. Migration to the SLNP peaked in the 1990s, with a total population of 20,000 estimated in 1998. The population grew an additional 25% over the next decade (Carr 1999; Suter and López-Carr 2010).

Central America in general and the Petén in particular have received large amounts of international financial support for purposes such as infrastructure development, conservation of natural resources and cultural patrimony, and tourism. The United States Agency for International Development (USAID), the World Bank, and the Inter-American Development Bank (IADB) have been some of the largest contributors, (Grandia 2007; Ybarra, Samos et al. 2012). The majority of the funding from the above sources has gone into infrastructure development such as roads. Despite the purported goals of much of this financial assistance towards promoting conservation, these campaigns have not effectively reduced deforestation nor widely promoted sustainable land use in the region (Shriar 2011).

Petén is undergoing a rapid economic integration with the rest of Guatemala, experiencing competition with their market crops at the national level and subject to the vagaries of the international market. Road building to and within the region has been an integral part of this process. The paving of the original all-weather dirt road between the national capital and central Petén in 1999 reduced travel time between the two nodes from a 14 hour journey to around 6 hours (Shriar 2006). Truckers can now more easily bring Petenero agricultural goods to the capital, but the reverse is true as well, meaning Petén farmers must compete with products grown elsewhere in Guatemala and imported from abroad. Shriar (2011) found that the amount of fruit traveling from the more southern departments to Petén increased 500-fold (from 10,000 kg to 5.1 million kg) between 1996 and 2004.

Infrastructure development in the region intensifies land speculation, with the expansion of ranching into peasant land as a low-labor intermediate use for the land. Ranches can subsequently be transitioned to more profitable ventures, such as African palm plantations, eco-tourism, fruit plantations, oil and mining, and drug trafficking (Grandia 2009). The goal of our research was to document and understand how the agricultural frontier changes over time with regard to population and land use, as well as the shifting cast of characters of land owners and land users in the example of the SLNP.

Methods

To better understand how an agricultural frontier changes with time, this study analyzes panel-data and cross-sectional data consisting of household interviews conducted with farmers living within the boundaries of the SLNP or its buffer zone during two time periods, 1998 and 2009. The second author conducted interviews with 247 randomly selected subsistence farmers in eight communities in 1998 (Carr, 1999, 2000). Questionnaires were comprised of questions concerning land use and farming techniques, household demographic characteristics, socio-economic and political-economic characteristics, and environmental/geographical characteristics of the household's agricultural land. Following a mixed methods approach, questions were primarily quantitative, with some open-ended qualitative questions (Cheong et al 2012).

In 2009 the first author returned to the eight communities to examine how the area had changed over the preceding 11 years as the frontier matured. Dr. Suter re-interviewed the same households, when present. Of the households interviewed in 1998, 63% were still present in the same community at the time of the second interview. At the time of the initial interview, the selected households had discussed any land they owned, whether through *de jure* or *de facto* land rights. In 2009, therefore, Dr. Suter interviewed the households who owned the land previously identified as belonging to the 1998 interviewees. This included many of the original 1998 land owners, as well as owners who had acquired the land since 1998. Dr. Suter also interviewed a cross-sectional sample of 213 randomly selected households in 2009. She adapted the questionnaires used in 2009 from those used in 1998 to include sections on the out-migration of whole households from the communities, on the out-migration of individuals from households, and on the sale and purchase of land which belonged to the 1998 interviewees at the time of the first interview.

We examined changes in population, household, and farming characteristics between the two time periods. Figures 2 and 3 explore how population growth varied between different communities. Table 1 shows how land uses have changed on average between the cross-sectional, randomly selected samples of the two dates. The households included in the analysis are only those which had access to farm land the prior year, whether owned, borrowed, or rented. This was a total of 241 interviewed households in 1998 and 203 interviewed households in 2009. Discussion of changes in the land use between the two periods is followed by a discussion on the changes in land ownership between the two periods. Because many older agricultural frontiers have become largely consolidated into the hands of relatively few owners, the goal in tracking who owns any particular land unit over time is to document the process by which land passes from the hands of peasant, subsistence farmers into the hands of larger-scale land owners as the area becomes more integrated into the national economy.

Results and Discussion

The number of households in all eight communities has increased by 59% between 1998 and 2009 (Figure 2), from 1064 to 1697 households for the respective years. This growth, however, has been uneven across different communities. The map depicted in Figure 3 shows the location of the subject communities, and demonstrates which communities experienced gains and losses in the number of households. Although all communities included in the study had at least ten families with farm-land located

within the park boundaries in 1998, the communities with the majority of their farm-land on the exterior of the park were primarily the ones who experienced a loss in the number of households. All other communities, despite having the majority of their land on the interior of the park and therefore supposedly limited from agricultural expansion by the park administration, grew in household numbers between the two dates. This suggests that the land regularization program promoted in the buffer zone of the park in the 1990s may have contributed to the hollowing of the frontier as private land becomes consolidated by elites, resulting in a declining population (Foweraker 1981).

Figure 2: Percent change in number of households per community between 1998 and 2009

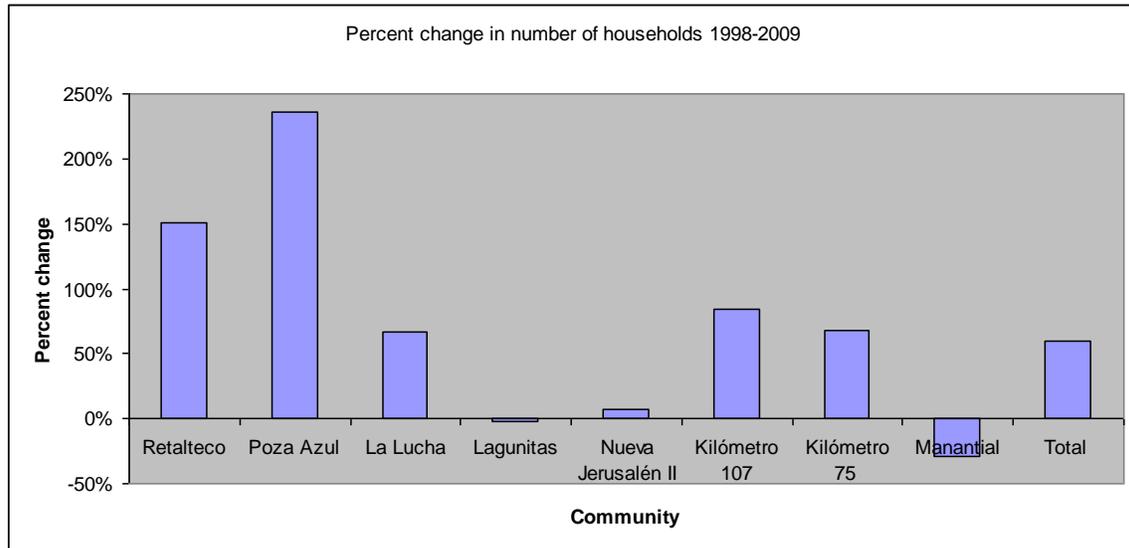
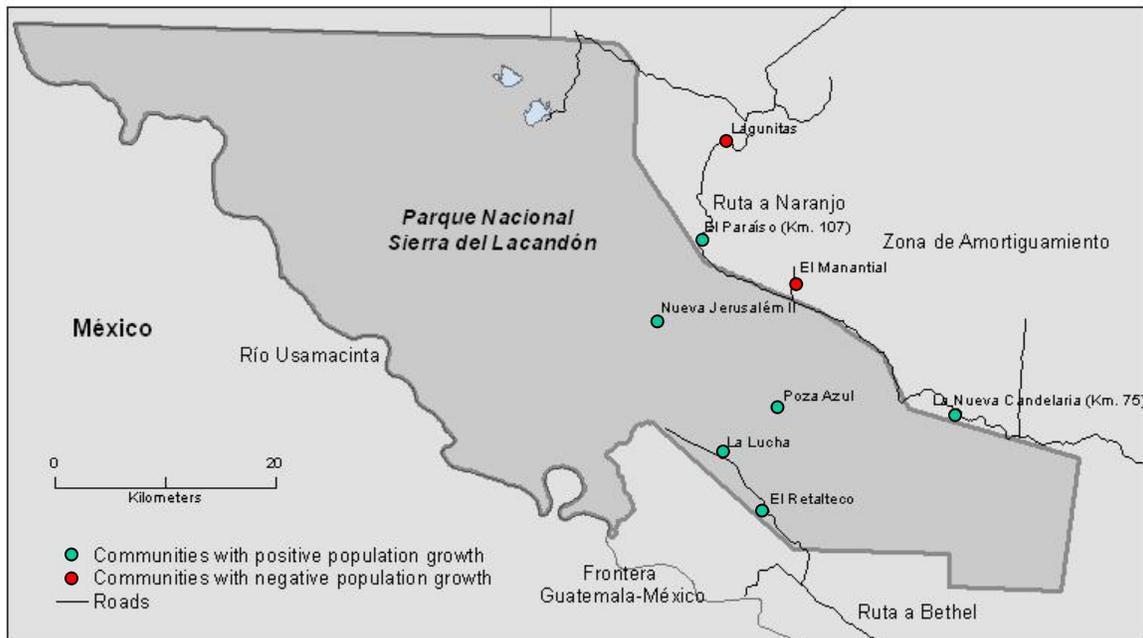


Figure 3: Detail of the study area



As Latin America rapidly urbanized in recent decades (Browder 1997; Chen et al 1998) and become more involved in global commodity trade (Grau et al 2005) some former frontier areas have experienced a shift from smallholder subsistence agriculture to large-scale export production (Futemma and Brondizio 2003), creating new challenges to sustainable development and conservation (Hecht 2005) while, as predicted by coupled development and forest transition theories (Mather, et al 1999; Rudel et al 2005), initiating forest regrowth in rural areas of some more developed nations (Aide et al 2013). Has the overall population growth and the continuing market integration of the area prompted households to intensify their agricultural production in the MBR? The evidence indicates that the opposite phenomenon is taking place, with an overall trend towards extensification. On average, households crop larger areas of higher value crops and less maize, but these changes have not kept pace with the expansion of pasture (Table 1). Pasture expansion is a main driver of tropical deforestation in Latin America (Carr et al 2006, 2009). Much of this more extensive land use has come at the cost of the forests, which in 1998 still comprised a large proportion of a farmer's landholdings. In contrast to 1998, when three-quarters of households had forest on their land (with forest comprising 44% of their landholdings on average), in 2009 only one-third of households had forest on their farm land, comprising 17% of the coverage of their landholdings on average. Households receiving remittances from the USA, though still not as prevalent as in the rest of Guatemala, have increased substantially since 1998. These remittances, however, did not appear to impact substantively the changes in land use for those households receiving them.

Many of the changes seen in this location are consistent with the trends that have been taking place across Petén in general. An increase in the area in cattle pastures and a decrease in maize cropping are not unique to this area. Though maize is an important food crop for the region with regard to food security, market related factors over the past decade likely accounts for the reduction in households farming maize in the region, as has been the case Petén-wide (Shriar 2011; Shriar 2012). The exception is the increasing prevalence in these frontier communities of black beans and higher value crops, though these are still not beyond a handful of perennial crops typical to small-scale farmers. This contrasts the declining prevalence of these crops across Petén, with the exception of sesame seeds. Although these frontier farmers respond to the same market forces as industrial-scale farming operations (e.g. by planting less maize as its market erodes), they also farm for food security; thus the increase in black bean for household consumption, and small amounts of the tried and true market crop, *pepitoria*. The area is still predominantly small farmers, and while they may emulate the local elite, ranchers, they still must survive by what they grow on their own farms. This is increasingly true for many households since their maize surplus no longer nets them much cash when sold, the cost of production has risen, and wages have stagnated.

Table 1: Changes in land areas and proportions between 1998 and 2009

	Year ¹	N ¹	Mean/ Proportion	Std. Deviation	Min.	Max.
Total land (ha)	1998	241	34.7	23.3	.7	135.2
	2009*	203	28.5	33.5	.7	179.0
Area of Maize (ha)	1998	241	5.0	4.3	.0	33.1
	2009**	203	3.3	3.6	.0	31.5
Area of pasture (ha)	1998	241	1.3	4.6	.0	45.1
	2009**	203	5.4	14.7	.0	136.4
Area in higher value crops (ha)	1998	241	.48	1.4	.0	9.9
	2009§	203	.81	2.2	.0	14.0
Total cleared land (ha)	1998	241	15.2	13.1	.0	67.6
	2009**	203	22.4	26.3	.0	139.2
Forest (0=no, 1=yes)	1998	241	.77		.0	1.0
	2009**	203	.35		.0	1.0
Area of forest (ha)	1998	241	19.5	18.2	.0	90.1
	2009**	203	6.1	14.2	.0	118.2

** = $p < 0.01$, * = $p < 0.05$, § = $p < 0.1$ (in comparison to the 1998 sample) as determined by the two-tailed independent samples t-test for continuous data or the two-tailed two-proportion z-test for binary data

¹ Comparison between the randomly selected households in both time periods, including only those households with access to agricultural land the prior year.

The area is simultaneously experiencing farm parcel consolidation and splintering. Half of the landowning households in 1998 sold their land by 2009. Many households who sold their land moved on from their 1998 community, choosing a new destination or on occasion returning to the area of their birth. The most commonly cited reasons for a household selling its land is to leave the community or to pay expenses related to a medical emergency (Suter and López-Carr 2010). Some of the sold land was consolidated into the holdings of large landlords, while other parcels became split among multiple owners. This is important for understanding land cover change in a region because the number and characteristics of households using land in an area strongly influence the types and qualities of different land covers present (Pan, Carr et al. 2004).

Overall, the number of land owners has increased over the years. In 2009, we confirmed that there had been 185 land owners in 1998, including both *de jure* or *de facto* land claims. By 2009 those original 185 land parcels from 1998 belonged to 244 owners, but this includes a parcel that the community converted into housing lots because of its proximity to the community center. Excluding that parcel, the number of owners of the original parcels was 212 in 2009, a 15% increase over the number in 1998. The original parcels were sometimes sold in sub-parcel portions, resulting in an estimated total of 230 parcels. This is a 24% increase over the number of parcels in 1998.

In several cases, the 2009 owner of the original parcel of interest did not live in either the community itself or an adjacent community and we therefore categorized them as an absentee owner. Table 2 shows the location of these absentee owners, split between more recent purchasers/inheritors or the original 1998 owner. Thirty-three of the 212 landowning households in 2009 are absentee owners, a total of 16%. The Petén in general has a long history of land speculation, as do many agricultural frontier regions (Schwartz 1987; Grandia 2009).

We cannot compare the rate of absenteeism in 2009 vs. 1998 because in 1998 the random sample was selected by households living in the community and not by land parcel, therefore omitting owners who do not live in the area. However, the fact that many of these properties formally held by subsistence farmers living and working in the frontier have been acquired by households living elsewhere suggests that land speculation may be a rising factor in this area. By nature, their absenteeism means that the first author was unable to complete a full interview with the current owners in 2009, and therefore we cannot say in most cases if they are vast landowners either in the region or Guatemala as a whole, though this theme will be developed in a more qualitative manner in future publications. In fifteen instances, however, both among owners living in the area and absentee owners, purchasing households owned multiple parcels belonging to the original 1998 interviewees by the time of the 2009 interview. This indicates that consolidation is taking place at the same time as fragmentation. Many of those who were able to purchase land in absentia were Guatemalans living in the USA. The impact of remittances goes beyond what is represented in Table 2, however, as a household was not categorized as absent if the spouse and/or dependent children lived in the community. Remittances therefore play a role in many additional purchases.

As Table 2 demonstrates, absentee owners are more likely to be among those who had purchased or inherited the land since 1998 rather than the original 1998 owners who held on to the land despite moving away from the community. In one case the original owner held on to a small parcel while he moved to the closest urban area with readily available medical care. In the other three cases, however, the original owners retained land which was part of a forestry cooperative. The absent owners were therefore able to continue annually harvesting timber for sale and thus extract an economic benefit from the land though they preferred to live in their origin communities.

Table 2: Location of new or original absentee buyers at the time of 2009 interview

Location	Absentee buyer/inheritor		Absentee original owner	
	N	% of column total	N	% of column total
Nearby frontier	1	3%	1	25%
Area Central	5	17%	0	0%
Other Peten	6	21%	0	0%
Other Guatemala	7	24%	3	75%
USA	8	28%	0	0%
Other foreign	1	3%	0	0%
Unknown	1	3%	0	0%
Total	29	100%	4	100%

Conclusion

These findings provide an overview of some changes that have emerged in this frontier area over the course of its development. Although population has grown substantially, this growth has been uneven, with some communities experiencing population declines. The results from our study suggest that although some SLNP landowners conscientiously try to preserve a stand of forest on their land, ultimately most of the internal frontier (that is, forest located on landholdings) will be felled. Those households that had cleared less land on their holdings in 1998 have mostly caught up with those who had converted more forest by that date. Households have little incentive to intensify while they still have land available from which to expand their production. Especially while cattle remains king in the area. The market is poor for most crops, or too variable for those crops that can (at times) garner higher prices. Whichever households have the means to produce beyond the level of subsistence, therefore, will likely continue to devote themselves to cattle. This situation has contributed to substantial land clearing in the SLNP.

In addition to the great forest impact documented in recent years in the MBR, environmental change was implicated in out-migration to the MBR initially (López-Carr 2013), and appears to be related to out-migration from the MBR to other frontier regions (Suter and López-Carr 2012). This process is intimately related to plot subdivisions. Some households came to the area as subsistence farmers, yet managed to have bought extensive land from their neighbors. Others are buyers who arrived later or who have chosen not to make their home on the frontier, owning their frontier land in absentia. The majority of smallholder households, however, will become progressively poorer over time, with access to smaller portions of land. These frontier households remain vulnerable, and the land they acquired is often the only asset of value they have to sell in time of crisis, such as a medical emergency or to repay a debt. Migrants continue to arrive, and natural growth remains high, with more and more people forced to rent land. The cost of living is rising at the same time there is a decline in the farming income to be gleaned from crops and stagnating wages for the little off-farm work available. Some households will migrate to other areas, such as the rapidly growing urban zone of central Petén, some will risk their lives and savings to reach the US, while others will join the “invasive” communities in the most restricted access zone of the park, felling more primary forest. The successful reconciliation of such human-environment tensions will be enhanced by local stakeholder involvement at local to international scales of policy and decision making (Carr and Norman 2008).

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