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GEOGRAPHICAL AND INDIVIDUAL DETERMINANTS OF RURAL OUT-MIGRATION TO A TROPICAL FOREST PROTECTED AREA: THE MAYA BIOSPHERE RESERVE, GUATEMALA

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Abstract

Migration necessarily precedes deforestation in tropical agricultural frontiers. Therefore, identifying individual, household and place characteristics (demographic, political, social, economic, and ecological) related to this process is crucial for understanding the drivers of tropical deforestation. This will in turn be useful for developing policies to reduce deforestation, which cannot be approached only from the destination end since this ignores the fundamental role played by migrant farmers advancing the agricultural frontier. This paper uses data from surveys conducted in areas of high out-migration, much to the agricultural frontier in northern Guatemala. Results suggest that larger family sizes, land scarcity, soil degradation, poor access to markets, low education, and poverty are linked to migration to the frontier in Guatemala.

Keywords: *Migration, conservation, land use, agriculture, frontier settlement.*

1. INTRODUCTION

A burgeoning literature has examined factors associated with a principal proximate cause of deforestation in Latin America and elsewhere in the developing world (World Bank 1991; Geist and Lambin 2001, 2002; De Sherbinin et al 2007): the extension of the agricultural

frontier.[1] While export agriculture has pushed the frontier from increasing urban demand for meat and soy, early migrants to these areas and continuing small farmer frontier settlement have driven much of the globe's tropical forest conversion. But where do migrant settler families come from and why? These are questions that must be addressed in order to explain the primary *underlying* demographic driver of deforestation. Specifically, what are the demographic, political, socio-economic, and ecological factors that induce people to migrate from origin communities to the agricultural frontier in forest areas? Probing this question requires identifying jointly areas of high out-migration and areas in which significant proportions of the out-migrants choose tropical and semi-tropical forests as their destination (López-Carr, D. and J. Burgdorfer 2013).

All but a few million of the several hundred million persons who migrate each year in the world migrate *internally*—from one location to another crossing a border within their own country, especially within developing countries. Yet research and publications on migration are distributed almost exactly the opposite way, with the vast majority focusing on international migration (and mainly on the developed world).[2] Furthermore, of the work on internal migration in developing countries, the vast majority was (and continues to be) on *rural-urban migration* and its corollary, urbanization, with very little on rural-rural migration, even though it remains larger than rural-urban migration in many countries with the necessary data (Bilsborrow and Geores 1992; Bilsborrow 2002).[3] With most research on migration in developing countries focused on rural-urban migration, to the extent this is extracted from primary data from surveys, it is based on surveys carried out only in (urban) destination areas (White and Liang 1996). Thus, rural-rural migrants have been largely ignored, although they are the key migrants in population-environment relationships since the vast majority of the migrants to the agricultural frontiers originate in rural areas. This then lays the ground for the main questions underlying the research reported in this paper: what characterizes the areas of origin of migrants to the agricultural forest frontier, who migrates from those areas of origin, and who chooses the agricultural frontier as their destination—that is, how are they different (selected) from those choosing other destinations? The research reported here attempts to shed some light on these questions based on one country, Guatemala, but does not purport to adduce generalizable findings at this early stage.

This paper is organized as follows. First, in the next section we review what is known in the literature, especially on Latin America, about why people leave rural communities, focusing on the characteristics of those communities that condition out-migration, especially to the agricultural frontier. We then describe the situation in Guatemala. This is followed by two short sections on migration and deforestation in Latin America, and specifically on Guatemala, to provide background on the importance of the issue and also set the stage for the case study of Guatemala, which is the main part of the paper. A short section then describes the various principal areas of origin of out-migrants from rural areas of Guatemala, focusing on areas sending significant numbers of migrants to the northern frontier. This section is followed by the methods of data collection followed by results presented on the extent of out-migration from the study communities and the factors associated with migration patterns. A concluding section summarizes the results and discusses their implications for policy and future research.

[1] Access of migrant colonists to the rainforest frontier is usually provided by other actors who build roads into the forests, notably loggers (especially in Asia and Africa), oil and mining companies (e.g., Ecuador and Peru), and the State (Brazil, Guatemala, Mexico, Panama).
[2] In a letter to a planning meeting for the preparation of the Montgomery et al (2003) book for the National Academy of Sciences, B. Cohen reported that 96% of the published articles in a cross-section of population-related journals in the previous three years were on international not internal migration.
[3] In a recent study, of the only 14 developing countries with internal migration data classified by urban and rural origin and destination in their population census (censuses of 1966 to 1995), rural-urban migration was the largest in 2 countries and rural-rural in 3 (urban-urban being largest overall). Rural-rural flows were larger than rural-urban in 10 of the 14 countries (UN, 2001, p. 66).

2. WHAT DO WE KNOW ABOUT WHY PEOPLE MIGRATE AWAY FROM RURAL COMMUNITIES IN DEVELOPING COUNTRIES?

A significant literature exists on why people migrate and why they leave their place of origin, drawing on the migration theories of Sjaastad (1962), Lee (Lee 1966), and Todaro (1969), and cited in Shaw (1988), Ritchey (1976), Greenwood (1981); DeJong and Gardner (1981), Bilsborrow et al. (1984), Massey (1990), White and Lindstrom (2005), and others. But these traditional approaches to migration focus on individual and household factors that influence migration. What is more relevant for this study is what are the place-related factors, which may be called structural factors (Wood 1982), that lead people to leave places of origin. Since we are concerned with rural areas of destination, to which most migrants are from rural places of origin, then this means we are interested in the factors that induce people to leave rural communities to migrate elsewhere, especially to rural destinations and particularly to the agricultural frontier. Among the geographical factors that may be linked to out-migration from rural communities are land tenure and land availability; land quality; availability of employment, including non-agricultural work, wage levels, and farm and non-farm household incomes; population pressures on the land (affecting land availability and distribution, and perhaps soil degradation); infrastructure, including schools, health facilities, and socio-economic and political infrastructure; presence of irrigation, if rainfall is unreliable; migration networks; and environmental conditions, including soil quality, forest cover, soil and water contamination, etc. The evidence adduced in the literature cited below will mainly draw on Latin America.

First, land is crucial, both the availability of land to households (land tenure, or who has it vs. how many do not own or have access to any land; the amount of land, distribution of land) and the availability of common lands to both those who may have land and those without land. When people have land, out-migration is attenuated (Johnston and Clark 1982; Wood 1982; Findley 1994; Bilsborrow et al. 1987; Mehta 1987; Shaw 1988; Marcoux 1990; Mc Nicoll and Cain 1990; Bravo-Ureta et al. 1996; De Jong and Winsten 1996). The availability of employment, agricultural and non-agricultural, is important for providing sources of income. Farm household incomes are increasingly dependent on off-farm employment of household members. Evidence on the importance of local employment opportunities abounds in the economics literature (e.g., Sjaastad 1962; Todaro 1969; DaVanzo 1981) and is also found in many studies, including Lindstrom and Lauster (2001) on Mexico; Bilsborrow et al (1987) on Ecuador, and Brown and Lawson (1985) on Venezuela. Income and land ownership differentials can also be key determinants of off-farm migration (Mörner and Sims 1985; Morrison and May 1989; Castillo 1995). Population pressures on the land have been found important in a number of studies in Latin America, including on the Dominican Republic (e.g., Zweifler 1994); Panama (Heckandon and Mc Kay 1984); Guatemala (Bilsborrow and Stupp 1997); Brazil (Almeida 1992; Wood and Perz 1996); Costa Rica (Carvajal and Geithman 1976); Ecuador (Rudel and Richards 1990); Honduras (Stonich 1989); and in the tropics in general (Barbier 1997; Rudel and Roper 1997; Carr et al 2009).

The population size of communities may help retain population, a belief implicit in the well-known gravity model in geography (see also Brown and Lawson 1985). The demographic composition of households in communities may also be important: Young, unmarried, or recently married adults are the most likely to migrate, often to establish a household (Carvajal and Geithman 1974; Perez 1985; Root and De Jong 1991; Almeida 1992; Chant 1992; Cruz 1992; Ram and Singh 1994; De Jong 1996). Migration networks, including previous out-migrants from a community (Findley 1994; Massey and Espinosa 1997; Lindstrom and Lauster 2001) have long been known to be key determinants of the

timing and destination of migration (see Hagerstrand 1957), supported, for example, in recent studies from Mexico (Davis et al. 2002; Curran and Rivero-Fuentes 2003).

It has long been hypothesized (e.g., Bilsborrow et al. 1984, Ch. 13; Findley 1987; Beauchemin and Schoumaker 2005) that the availability (or not) of various forms of infrastructure may affect out-migration from rural communities, including schools, health facilities, political infrastructure, banks, irrigation, road connections to provincial and national capitals, etc. In a study at the community level, based on 27 rural communities in Ecuador, Bilsborrow and Ruiz (1990) found that more schools and good road connection were associated with out-migration but irrigation works led to higher agricultural incomes and less out-migration. The focus of geographers on "place utility" differences affecting migration is related to infrastructure development (see Wolpert 1965).

Lastly, a handful of studies suggest that environmental degradation may affect out-migration from rural areas (Hecht 1983; Schneider 1993; Browder 1997; Bilsborrow 2002; Adamo 2010), although empirical evidence is as yet virtually non-existent, except for studies showing the importance of the availability and timing of rainfall (Henry and Schoumaker 2004; Beauchemin and Schoumaker 2005) and drought (Findley 1994; Ezra and Kiros 2001). In a recent study on out-migration from 36 rural communities in the province of Loja in the southern Andean highlands of Ecuador, Gray (2008) found out-migration lower from those with more rainfall. On another environmental measure, Nepal, Shrestha and Bhandari (2005) found the increasing scarcity of fuelwood and time to collect fuelwood related to out-migration. The vast majority of the studies cited above on the characteristics of rural communities that affect out-migration, however, are based either on (a) broad, descriptive historical studies, without quantitative data at the local community level for a reasonably large number of communities, or (b) household survey data, without the inclusion of measures of infrastructure, land, employment, etc., at the community level.

We noted above that part of the purpose of this research is to study factors that influence the choice of destination of migrants exiting from rural communities in Guatemala, particularly the choice of a frontier destination. There is little quantitative research on this on developing countries, due to both data and analysis limitations. First, most existing studies on the frontier are based on survey data collected only in destination areas, which this paper begins to address. It is widely thought that the rural landless are more likely to migrate away from a rural community, and more likely to the frontier, than those with land (Marcoux 1990; Barbieri and Carr 2005; Barbieri et al 2009). Research on frontier colonization has also consistently found that the primary pull factor to the frontier is perceived land availability (e.g., Henkel 1994; Fujisaka et al. 1996; Pichon and Bilsborrow 1999), including in the Maya Biosphere (Carr 2008; Corzo-Márquez and Obando 2000). Additionally, several studies suggest that rural-frontier migrants are less educated and poorer than non-migrants or migrants to other destinations, including Mougeot on Brazil (1985), Carvajal and Geithman on the Dominican Republic (1976), and Laurian et al. on Ecuador (1998). As is the case for other types of migration, migrant networks affect these moves (Entwisle et al. 1998; Laurian, Bilsborrow et al. 1998).

Research on migration to the frontier has grown rapidly in recent years, but is logically based and heavily concentrated on the destination areas themselves, viz., the frontier forest destinations of migrants (see reviews in Geist and Lambin 2001; Bilsborrow 2002; Entwisle and Stern 2005). There has been virtually no data collection on areas of origin to study why people leave those areas for the frontier, despite this being a fundamental part of the process of explaining the causes of tropical deforestation. Therefore, the research presented here presents data from perhaps the first survey specifically designed and carried out (in 1999 and 2000) in communities of high out-migration to an agricultural colonist frontier.

3. MIGRATION AND DEFORESTATION IN LATIN AMERICA AND GUATEMALA

From the 1960s through the 1980s, nearly 2% of rural Latin Americans out-migrated annually, exceeding the rates of other regions in the developing world (Chen et al 1998; Carr et al. 2009). This is documented by data from a series of population censuses, showing the effects of rural-urban migration and fertility decline on decreasing the rural population by 4%. Rural population density fell from 1.0 to 0.9 persons per hectare of arable land, but still attended by continuing deforestation (Carr et al. 2009). Latin American forests have been felled hastily despite a relatively small (and, in many cases, declining) rural population, a phenomenon corroborated by the case study literature (e.g., Brown and Pearce 1994; Bilsborrow and Hogan 1999; Geist and Lambin 2001; Wood and Porro 2002). During the first half of the 1990s, Latin Americans deforested five times more forest per rural person than Africans and 40 times more than Asians (Carr et al. 2009).

Despite the great absolute amount of forest cleared in *South* America, no major world regions lost a greater percentage of its forest cover in recent years than *Central* America. From 1966 to 1994, over 45 million hectares of forest were felled, a full 43% of the region's 1966 remaining forest cover. During this time, rural population increased by 12 million (32%) while rural population density increased by only 14% (offset by continued farmland expansion). In Central America, as in Latin America as a whole, it appears that the modest fraction of migrants who colonized remote frontiers (rather than migrating to other rural destinations, cities, or abroad) was responsible for a disproportionate amount of the forest loss.

4. RURAL-RURAL MIGRATION AND DEFORESTATION IN GUATEMALA'S PETÉN

Farming, logging, and urban expansion claimed an astounding 38% of Guatemala's forest cover between 1966 and 1994 (Carr et al. 2009). At the end of the 1990s, no other country in Latin America—and only seven countries worldwide—possessed as much remaining forest as Guatemala (over 28,000 km2) while at the same time having cleared forests at an annual rate of at least 1.7% during the decade of the 1990s (FAO 2001). Most of the forest clearing in Guatemala during the last decades of the twentieth century was to open agricultural land in the vast northern *departamento* (similar to a US state) of Petén. As most of the southern half of the Petén's forests was already cleared by 1979, migration since then has come to increasingly threaten the *departamento*'s northern forests, most of which are located within the Maya Biosphere Reserve (MBR). The MBR, occupying the northern half of Petén, forms the heart of *La Selva Maya*, the largest lowland tropical forest in the Hemisphere north of the Amazon (Figure 1).

Figure 1. *Departamentos* of Guatemala and Migration Origin *Municipios*.

Since the 1960s, Petén's population has exploded from a few isolated chicle extractors to approximately 350,000 people (Instituto Nacional de Estadistica 2002), and is projected to approach one million by 2020 (Grandia 2000). Based on estimates of fertility for Petén, we estimate that at least two-thirds of Petén's 9% annual population growth from the mid-1960s through the mid 1990s was due to net in-migration. And given that most current unoccupied land is located within protected areas, subsistence farmers migrating to the region searching for land will increasingly have little choice but to continue colonizing protected areas. Further incentivizing Peten's settlement were government incentives and the offer of land concessions to colonize Petén and other areas, such as the Franja Transversal del Norte in 1960s-1980`s (Schwartz 1995).

Since the 1970s, most migrants to Petén have been land-poor maize farmers, approximately half Q'eqchí Maya. The migrants are generally under 35 years of age, with the most important inter-*departamento* streams originating from the east (Schroten 1987). Migrant colonists have been the principal agents of the dramatic landscape changes in Petén. From the 1950s to the mid 1990s, nearly half the Petén's forests were eliminated (Aguayo et al. 1987; Leonard et al. 1989; Katz 1995). The deforestation process in the region has been documented by a host of scholars (e.g., Jones 1990; Colchester 1991; Schwartz 1995; Sader et al. 1997; Grunberg 2000). During the 1990s, the most active agricultural frontier in Petén was the region of the Sierra de Lacandón National Park (SLNP) and the surrounding region accessed by the road to the nearby frontier town of Naranjo, built by oil interests in the 1980s (Carr 2008).

5. AREAS OF MIGRANT ORIGIN TO PETÉN'S AGRICULTURAL FRONTIER

Much of the Mayan territory continued to remain free of Spanish control until the coffee boom of the 19th century (Mc Creery 1994). During the ensuing decades, the expansion of coffee plantations resulted in thousands of Maya becoming evicted from the Pacific piedmont

and Verapaz highlands (Mc Creery 1994; Lovell 1999). A boon for the government and wealthy *patrones*, the creation and expansion of large coffee plantations for export (Valenzuela 1996) led to indigenous lands being reduced to half their prior total area (Smith 1984).

By the 1970s, decades of plantation expansion and high rural population growth conspired to marginalize subsistence farmers on ever-dwindling plots of land. According to the agricultural census of 1979, the mean amount of cultivable land per capita in the country fell from 1.71 hectares in 1950 to 0.79 hectares in 1979. As early as 1964, 44 percent of all landholders had fewer than 1.4 hectares, the minimum needed to support an average size rural household, according to the National Planning Organization (SEGEPLAN 1987). These 44 % of the farmers had only 3.4% of the farmland, while the 2.1 % of the farmers with the largest farms (over 45 ha) owned exactly two-thirds (66.5%) of all the farmland. In the subsequent 15 years, the number of farms in Guatemala grew from 419,000 to 606,000, or by 45%. But virtually all this growth was in the smallest size group under 1.4 hectares, which grew from 183.7 to 361.5 thousand (SEGEPLAN 1987; Bilsborrow and Stupp 1997). Meanwhile, the total land area in these farms grew by only 29%, meaning that the mean size of these many sub-subsistence farms actually fell significantly, from 0.73 ha to 0.48 ha, indicating a miniaturization of *minifundia* [4] As of 1979, this group comprising 60% of all farms owned only 3.7% of the farmland, while those with over 45 ha--2.3 % of the total--had increased their share of total land in farms to 67,1 % The most recent agricultural census suggests that land distribution remains skewed with under 20% of landowners controlling over 90% of all agricultural land (INE 2003).

Rural Guatemala is textured by unique economic, historical and environmental conditions, which have produced a common denominator of increasing population pressures on the land and rising resource-access inequalities. Along the volcanic Pacific slopes, the coffee export industry expanded landholdings, diminishing possibilities for smallholders to compete for farmland (Mc Creery 1994).[5] Thus in the 1940s and 1950s, expropriated German farms were made available to farmers. By the 1980s, most of this land had long since been distributed, so the most recent land reform colonies, including some land distributed to returning refugees, have been transformed into fairly typical examples of Guatemalan small farm agriculture, including share-cropping and renting of small plots (Jones 1990). In the southeastern coastal plains, beef, cotton, and fruit plantations swelled in the 1970s and 1980s, augmenting pressures on smallholders (Valenzuela 1996). In the western Altiplano highlands and the Verapaces, generations of high fertility have led to ever-more fragmented land parcels to below subsistence size and contributed to soil degradation (Wilson 1995; Bilsborrow and Stupp 1997). In the southern Petén, the early rush of colonization in the 1970s and 1980s filled the land within viable access to roads and led to substantial deforestation. With the concomitant expansion of cattle ranching, colonists were forced to search for land in the new, more distant frontiers of the Petén, such as in the protected SLNP (Schwartz 1995).

Compounding these factors, pressures from centuries of land inequity and rural poverty contributed to the political factors that erupted in civil war in 1976, launching a mass exodus of peasants from the land, a migration event eclipsing all others in the modern history of Central America. Tens of thousands died and up to a million peasants were displaced by violence, mostly from the *departamentos* of Alta Verapaz and Ixcán. Approximately 100,000

[4] Guatemala had agricultural censuses in 1950, 1964 and 1979—the last one before the survey data collection reported below. Subsequently, Guatemala had a census of agriculture in 2003, and a census of population in 2002. All data on land sizes are converted to hectares from the units used in Guatemala, *manzanas* (one manzana = 0.7 ha = 1.7 acres). Unfortunately, the 2003 agricultural census does not provide adequate data on land tenure to estimate an updated Gini coefficient indicating the distribution of landholdings, so the most recent estimate is still that from the 1979 agricultural census. The value for Guatemala of 0.72 indicates a great concentration of landholdings, the fourth most unequal in Latin America (Herrera 2005).

[5] In recent years, this has resulted in a massive seasonal labor migration of land impoverished Maya from the highlands to the Pacific coast and into Chiapas, Mexico, to work on cotton and coffee plantations (Martinez Velasco, 1993).

fled to Mexico (Aguayo, Christensen et al. 1987). Civil war thus became a major cause of out-migration from rural areas of Guatemala during the 1970s and 1980s, intensifying as the violence escalated (Morrison 1993). A 1996 peace covenant brought the protracted violence to an official denouement (Lovell, 1998).

Nevertheless, the covenant did not reconcile the conditions that gave rise to civil war in the first place. The severity of the population-land pressure situation in Guatemala is illustrated by a comparison to the US state of Ohio. The size (108,429 km^2) and population (approximately 11 million) of Guatemala and Ohio are almost identical (World Bank 1998). But imagine how resource pressures might constrain rural economic development in Ohio if over half the citizens were farmers. Imagine if land were distributed such that 90% of farms accounted for only 16% of total farm area while 2% of landowners controlled 65% of the land (World Bank 1995). Finally, consider that the most fertile areas are managed for export agriculture and that most rural families have to support their families on 1.4 hectares or less.

With such skewed resource access, it is not surprising that 85% of Guatemalans live in poverty. In 2000 GNP per capita ($1,690) was among Latin America's lowest (World Bank 2001), yet most rural Guatemalans earn considerably less than this. Indeed, Guatemala remains a net importer of grains despite the fact that 58% of the population consists of farm families—virtually all of whom produce staple grains, primarily milpa (corn) (World Bank 2001).

Aggravating semi-feudal land concentrations and pauperesque economic opportunities, the highest rural total fertility rate in Central America (6.1 births per woman, according to the Guatemalan National Statistics Institute, 1996) has led through land inheritance over time to the geometric contraction of farm plots. Bilsborrow and Stupp (1997), for example, concluded from their study on fertility and land use in highland communities that population growth contributed to a sequence of land fragmentation, soil degradation, rural out-migration, some to the northern Petén, and rapid deforestation there.

This present paper aims to use data from an almost unique type of data collection to address the questions of how have such diverse demographic, economic, political, and ecological processes contributed to the migration of households to the Petén from different areas of rural Guatemala?

6. METHODS

6.1 Selection of Origin Study Sites and Communities

Data were collected in a number of rural areas throughout Guatemala, following the implementation of a previous survey of households who had migrated to and settled in and near the Sierra de Lacandón National Park (SLNP) in the western part of the Petén, bordering Mexico (see Figure 1). For purposes of this study, we selected two to three *municipios* (roughly similar in size and population to counties in the United States) from each region of highest migration to the destination *municipio* of La Libertad, the main colonization frontier of the Maya Biosphere Reserve during the 1990s and home to the SLNP. These regions, covering most of Guatemala except the Altiplano or Western highlands (which has relatively few migrants to the Petén), are the Pacific Coast, the South, the East, the Verapaces just south of the Petén, and the Petén itself (see Figure 1).

Municipio selection was based on data from three sources: household surveys carried out earlier with 241 household heads in 8 communities in the SLNP (Carr 2003; 2005); community-level interviews in 28 communities of destination in the SLNP (Carr, 2008); and data from the 1993 census of population on inter-municipal migration (Instituto Nacional de Estadistica 1993). The latter was the main source of data for selecting municipios, since the

census covered the entire population of La Libertad and the rest of the country in 1993. In contrast, the sample of 241 households interviewed in 1998 and again in 2009 could cover only a small part (the area representing perhaps one-third of all migrants to the Maya Biosphere Reserve during the 1980s-2009) of the rural population of the destination study region. The *municipio* is the smallest political unit with census and other data generally coded and available in Guatemala. The *municipio* of La Libertad contains the main colonization frontier of Guatemala in the 1990s. Migrants to La Libertad in the census were defined as the number of residents in the 1993 national census living in La Libertad who had been living in another *municipio* five years before, in 1988. The total number of migrants to La Libertad from each *municipio* of the country was then tallied.[6]

Municipios within each region were selected according to the following criteria (a) those with the highest levels of out-migration to La Libertad, according to the census; (b) when there were several with similar levels according to the census, choosing those which had more migrants to the SLNP according to the SLNP household survey (this was done in selecting Gualan in the Southeast, and Nueva Concepción, El Asintal and Santa Cruz Mulua, on the Pacific Coast).[7] An important exception to the general selection procedure was that six communities were selected which did not have any migrants to the SLNP, reported in the household survey in the SLNP. These six therefore serve as control communities. The Appendix tables lists all of the *municipios* in the origin sample, including their *departamentos* (like a province or state) and region. It also lists the study communities in each *municipio*, with the names replaced with fake names to protect the confidentiality of the actual communities and respondents.

6.2 Questionnaire Design: Data Collected

Interviewers were carried out with community leaders in 1999 and 2000 by the co-authors. Those interviewed were most often mayors (alcalde auxiliary) or members of the town or community council or development committee (comité de pro mejoramiento), and occasionally health promotors, teachers, religious leaders, heads or members of agricultural or women's committees, etc. The purpose of the survey was first explained, then the interview carried out over an hour or two with usually several persons together, since this reduces biases in responses and also reduces gaps in data due to lack of knowledge.

The questionnaire included four sections, on the community, migration, land use, and family health (further details are in Carr 2003 and 2008). Each section offered ample opportunities for additional qualitative information and comments, beyond the specific, usually quantitative structured questions. Indeed, informal conversations were carried out with individuals apart from the formal group interviews, and household surveys were also implemented with 18 households. Both quantitative and qualitative data were collected. The value of this combination was demonstrated in the first studies of migration from Mexican communities to the USA by Massey et al. (1987) in the famous study, *Return to Aztlan*, and has been much emulated since in studies on migration and development.

The first of the four sections included general questions when the community was founded, its size and geographic area, and approximate population size/number of families; most common materials of dwellings; percentage of dwellings with electricity, or which cook using fuelwood; source of community water; percentage with letrines vs. nothing; and percentage of household heads involved in non-agricultural work. Some of this information

[6] As much as half of the *municipio*'s population is located in the vicinity of the *municipio* capital, also named La Libertad. Nevertheless, this small municipal capital had grown by no more than a few thousand people during the previous two decades, during which the rural colonization region of the SLNP received most of the migrants. For these reasons, it is safe to assume that most of the migrants identified in La Libertad in the1993 census had migrated to the rural region of the SLNP.

[7] Fray Bartolome de las Casas was selected in the Verapaces due to another municipio being inaccessible due to flooding.

was asked for 10 years earlier or 1989-90 as well. Further questions inquired about language, ethnicity, religion, literacy, schools, where agricultural products of the community are sold, and existence of community organizations.

The section on migration collected information on temporary or seasonal work away from the community by community residents as well as on those leaving to live elsewhere, or "permanent" migrants, inquiring about both individuals and whole families that had left in the previous 10 years (since 1989-90), their three principal destinations, the main reason people left for each of the three, whether armed conflict was ever a reason, and whether the migrants ever sent money back to the community.

The section on land use, the longest, inquired about land tenure norms and rough land distribution in the community and changes since 1989-90, possession of cattle by families, use of credit, land conflicts, inheritance practices, differences in land ownership by ethnicity, existence of community lands for common use, type of corn grown, size and value of typical farm and its land use and production; three most commonly grown crops; use of agricultural inputs; and problems if any with each crop.

Finally, the section on health obtained data on major illnesses of adults and children under age 5, whether the community had a health facility or health promoter, location of/distance to closest hospital; availability of contraceptives; estimated proportion of women using contraceptives of any type, receiving prenatal care and attention at birth, whether couples have more or fewer births than they desire and why; whether they think their children will have enough land in the community when they become adults, whether they will leave the community, and what are the main needs of the community.

7. RESULTS

This section presents results from the analysis of the data for the 28 communities. Although the sample size of control communities—six selected at random from the same selected sample *municipios* which did not have known out-migrants to Libertad—is small, it provides useful insights. In the discussion of results below, we note where there are differences between the control communities on average and the other 22 communities selected for their having some out-migrants to La Libertad (which will sometimes be referred to below as the "migrant communities"). Because six is such a small number, the measures of "average" or central tendency used for comparison will sometimes be *medians* even when means are reported for the 28 communities as a whole in the tables.

7.1 Migration Patterns

Consistent with migration patterns in rural areas in much of Latin America, about half of the men and women from the origin communities surveyed engaged in some kind of seasonal or temporary migration for work during the previous several years prior to the survey in 1999-2000 (Table 1).[8]

[8] It should be noted that 5 of the 22 cases of communities reporting significant temporary out-migration reported its duration being a year or more, which demographers would usually classify as "permanent" rather than temporary migration. But most of these had returned by the time of the survey.

Table 1. Geodemographic characteristics of temporary migration from 1989 to 1999

Temporary Migration		
Percent of adults engage in temporary migration from 1989 to 1999		**Approximate Mean**
Men		50%
Women		50%
Principle Destinations	**Primary employment**	
Guatemala City	Factory or service worker	30%
Local towns and plantations	Agricultural laborer/Service worker	30%
Peten	Agricultural laborer	20%
Alta Verapaz	Plantation laborer	10%
USA	Factory, service, or agricultural worker	10%

Source: Interviews with community leaders in 28 communities of migrant origin throughout rural Guatemala

Guatemala City and local towns and plantations were the two principal destinations for temporary migrants, reflecting the effects of the one large city in the country and of local areas. While both are consistent with a gravity model interpretation that is overly facile, though geographical proximity to employment opportunities evidently is important. While seasonal migration to local plantations/farms and the municipal capital was greater than that to southern Petén and Alta Verapaz (which is on the way to Petén), both of the latter are quite significant, and doubtless provide contacts and knowledge that facilitates later permanent migration to Alta Verapaz and ultimately Petén. Migration to Guatemala City and to the US dominated temporary migration patterns from the Southeast and Pacific Littoral. A greater percentage of temporary out-migrants had worked at some time or lived in the more proximate regions of southern Petén and Alta Verapaz than in the less developed frontier of northern Petén. Nueva Concepción in the Pacific Littoral was an exception to this pattern, reporting high rates of out-migration principally to northern Petén. This appeared to be associated with a strong desire for land ownership based on a socialist land distribution program in Nueva Concepción many years earlier, in the 1950s. Nueva Concepción was one of only two municipios to carry out socialist president Jacobo Arbenz' largely unfulfilled dream of land redistribution (Valenzuela, 1996).

The control communities had a slightly higher percentage of men (55) involved in temporary out-migration than the 22 non-control communities (with out-migration to Petén), but an equally smaller percentage of women (37), indicating no real overall difference. Overall, communities reported a decline in temporary out-migration compared to 10 years before. Since overall economic conditions did not improve over the time period (see below), this decline may well be linked to the significant permanent out-migration, which might have substituted for some of the previous common seasonal migration.

The more important data for purposes of this study are those on "permanent" or long-term migration, which involves a change of residence. 10% of the adults (same percentage for men and women) in rural origin regions were reported to have permanently migrated away from the 28 sample communities during the ten years prior to the field work in 1999-2000 (Table 2).

Table 2. Geodemographic characteristics of permanent migration from 1989 to 1999

Permanent Migration		
Percent of adults permanently out-migrating from 1989 to 1999		**Approximate Mean**
Men		10%
Women		10%
Principal Destinations	**Primary employment**	
Guatemala City	Factory or service worker	35%
Peten	Acquire land for farming	35%
USA	Factory, service, or agricultural worker	10%
Other	Plantation laborer	10%
Principal pushes/pulls		
Work		35%
Land		30%
Improve living standard/education		20%
Natural disasters/Env. Degradation		10%
Remittances	**From migrants to the following places:**	**Proportion sending**
	USA	Almost all
	Guatemala City	Some
	Peten	None

Source: Interviews with community leaders in 28 communities of migrant origin throughout rural Guatemala.

There was no difference in these percentages between the 22 study communities and the 6 control communities. As documented elsewhere (Morrison 1993), permanent out-migration was very high from many communities during the height of the civil war in the 1980s, though out-migration peaked later to areas of more recent settlement, as the agricultural frontier in Petén and Alta Verapaz in contrast to the Southeast and the Pacific Littoral.

At least as many permanent migrants from the sample communities settled in Guatemala City as in Petén—despite the sample being selected on the basis of having out-migrants to the SLNP. This highlights an important concept: despite the great ecological impacts of rural-frontier migration in Guatemala, such migrants are highly selective and relatively rare even in areas where conditions are propitious for such migration. It also highlights the powerful force of attraction of the one major urban cynosure in Guatemala, the one metropolitan area of Guatemala City, with a population exceeding 1.0 million, with no other city over 100,000 (un.org/desa/population). Thus 72% of all permanent out-migrants from the 28 communities were reported to have chosen one of these two destinations. Factory, construction or service work was the usual goal in the capital whereas land to begin a farm was the main pull to Petén. The US and other destinations within Guatemala account for the remaining 28% of permanent out-migrants. Factory, service sector, or agricultural work were the main attractions for migrants to the US.

Consistent with relative employment and wage opportunities in the three primary destinations of permanent migration, remittances (significant in size as well) are almost always sent by migrants to the United States, sometimes by migrants to Guatemala City, and rarely or never by migrants to Petén or other Guatemalan destinations (for more on remittances and agricultural change in Guatemala see Davis and Lopez-Carr 2010).

More relevant for this particular study are reasons given for why people left the community. In the six control communities, lack of land was reported as a significant inducement to out-migration for only one community, with lack of work the main factor in three of the six, suggesting a strong off-farm employment orientation. In contrast, of the 16 reporting communities with significant out-migration to La Libertad, by far the most commonly cited factor in out-migration was lack of land, in six of the 16. This was followed by three reporting lack of local work opportunities, two on lack of education or other

services, and two on floods. Finally, there is a bit of evidence that people left some origin communities due to environmental degradation, with poor quality of land cited in one community. A second difference between control and migrant communities is the impact of violence: in 10 of the 22 migrant communities, violence was reported as a factor impelling out-migration at some time in the past, whereas this was not the case in a single one of the six control communities.

The next several sub-sections describe characteristics of communities in relation to these differential migration patterns in *municipios* of relatively high out-migration to the Petén frontier (22 of the 28 sample communities) and the six control communities.

7.2 Demographic Factors and Health

Population. Overall, population factors in themselves (in contrast to population pressures on the land, discussed below) were not significantly related to out-migration. First, the population sizes of the migration and control communities were about the same. Second, while family sizes of the 28 communities, in the sense of the modal number of children women gave birth to, generally ranged from four to six, and were about the same in the migration and control communities. These levels were also about the same as in rural Guatemala as a whole, judging from the latest national demographic survey (INE 2000). Not surprisingly, the typical numbers of births women have in these rural communities are smaller than the SLNP average of 7 (Carr, 2008), which is to be expected since fertility levels on the frontier, where land is plentiful, are usually higher than elsewhere. Community leaders did proffer that more children increase the likelihood of out-migration by family members, but this was quite subjective and does not necessarily mean that it increased the out-migration of whole families, only of individuals from larger households, which has been found in several previous studies (e.g., on Ecuador, Laurian et al. 1998; Barbieri et al. 2009). Most community leaders also reported that frontier migrants tend to be married whereas migrants to Guatemala City or the US were more often single and frequently met partners in those destinations.

Health. Though generally inadequate, health care and the availability of health facilities and personnel is significantly better in origin communities than on the frontier: People do not migrate to the frontier to improve access to health! Since there is a bit of literature showing that better access to health care in rural areas sometimes reduces out-migration (see section above on literature review), the main relevant issue here is whether health facilities were better in the control communities than in the selected out-migrant communities. Most measures indicate little difference between the two groups. First, the reported main illnesses did not differ. Second, the availability of at least a rural health post (puesto de salud) was the same, with 36% overall (Table 3) having some facility (2 of 6 control communities and 8 of 22 migrant communities—about the same).

Table 3. Primary illnesses for adults and children under five

Health					
Primary Illnesses					
Adults	**Mean**				
Malaria	32%				
Dengue	18%				
Respiratory illness/viruses	21%				
Arthritis	14%				
Children under five					
Diarrea	39%				
Common cold/influenza	29%				
Parasites	14%	Predominantly indigenous	Predominantly Ladino	Petén and Verapaces	Other Regions
Communities with health promoters	80%	-	+	-	+
Communities with Health Centers	35%	-	+	-	+

Source: Interviews with community leaders in 28 communities of migrant origin throughout rural Guatemala.

Those communities without a health center were rarely further than twenty kilometers from a municipal center with pharmacies and health centers with full-time health staff, in contrast to the situation in SLNP Petén frontier, where many population study centers there were over 100 kilometers from the nearest. Third, access to professional care or midwives at birth did not differ, nor did access to family planning methods. However, while overall most communities had a health promoter, *promotor de salud*, this.was universal among the six control communities compared to 13 of 18 having a *promotor* in the migrant study communities.

7.3 Political-economic Factors

Of the 28 communities, only 12 report any families having access to credit, usually only the 10% of the large farmers and ranchers (Table 4), with little difference between the control communities and the migrant communities.

Table 4. Political, institutional and macro-economic factors

Political, Institutional, and Macro-economic Factors						
	Median	Mean	Predominantly indigenous	Predominantly Ladino	Petén and Verapaces	Other Regions
Receive Credit	10%	10%	-	+	-	+
Price of a one manzana plot (.7 ha)	Q10,000	Q15,000	-	+	-	+
Market access	0	2.6 km.	-	+	-	+
Communities that suffered violence		36%	+	-	+	-

Source: Interviews with community leaders in 28 communities of migrant origin throughout rural Guatemala.

A prerequisite to receiving credit is land ownership. In origin communities, only relatively wealthy households owned land, which has become priced far out of reach for the majority: The average cost of a one *manzana* (0.7 hectares) farm, 15,000 *Quetzales* (or $2,500 US dollars at the time of data collection), in a nation where daily salaries were around 3 US dollars provides further context for the 60% landless rate reported in the origin study communities. The landless rate was even slightly higher among indigenous communities (75%). The landless are at particular propensity for migration to the Petén frontier.

Market access, measured by whether the community has its own market or if not by the distance to the nearest place where agricultural produce can be sold and basic household goods purchased, was far superior to the Petén frontier (Carr 2008). But the majority of the 28 communities do not have a market, which did not differ between the migration and control

communities. Informants invariably considered that improved access to markets favors migrant retention.

Violence was a major migration push factor from many rural areas of Guatemala during the 1980s and early 1990s. Up to one million people were displaced by violence, the vast majority internally displaced (Lovell, 1999; Morrison 1993) though many also fled to Mexico. Leaders in 36% of the communities said that their community was directly affected to some degree by the civil war, with violence having occurred in the community. However, this was reported to have directly led to out-migration from only one of the 28 communities (see Table 2), in contrast to hard hit regions such as the northern Highlands near the Mexican border (e.g. Menchu and Burgos-Debray, 1984; Castaneda, 1998).

7.4 Socio-economic Factors

Ethnicity, religion, and education. Nearly identical to the ethnic makeup of the SLNP, most of the origin communities were comprised of Ladinos of mixed Spanish-indigenous descent (Carr 2008, and Table 5). This was the same for the control and migrant communities, and similar to that of the SLNP where Maya groups comprised roughly 30% of the population. This differs from the national average of approximately 50% indigenous (INE 1999). Most of the indigenous population of Guatemala resides in the western highlands, an area of relatively few recent migrants to the Petén frontier (most migration from this region is seasonal to the Pacific coast for sugar cane harvesting or into Mexico for coffee harvests).

Table 5. Ethnicity, religion, and education profiles

Ethnicity, Religion, Education	Median	Approximate Mean	Predominantly indigenous	Predominantly Ladino	Petén and Verapaces	Other Regions
Ethnicity						
Ladino	80%	60%				
Other	20%	40%				
Religion						
Catholic	90%	70%	-	+	-	+
Evangelical	0%	20%	+	-	+	-
Other	0%	10%	+	-	+	-
Literacy						
Men	75%	70%	-	+	-	+
Women	63%	60%	-	+	-	+
Children in primary school	90%	75%	-	+	-	+

Source: Interviews with community leaders in 28 communities of migrant origin throughout rural Guatemala.

The religious composition of the study communities is indicated in Table 5 as well, with the vast majority being Catholic, as expected. But evangelical missionaries have been very active in Guatemala for decades, so there are some communities with large evangelical populations, as indicated by the figures for means. Nevertheless, there was no evident difference in religious composition of the 6 control communities and the 22 migration communities.

In terms of education, three-quarters of the men in the 22 out-migrant origin communities were able to read and write, compared to only 50% in the 6 control communities, though the percentages of literate women were around 60 in both. This may indicate that migrants are more likely to come from communities with more educated populations. This in turn could well imply that such communities stimulate aspirations for higher living standards and hence out-migration from these poor rural communities. However, those migrating with more education would certainly be mainly migrating to Guatemala City or the USA, while those migrating to the SLNP, based on the survey data collected there, were those at the low end of

the education ladder. Consistent with the data for males, community informants report a median 90 percent (and a mean of 75 percent) of school-age children attending classes, in contrast to a lower figure of 70% for the six control communities. The 75% literacy rate for males is very similar to the national average, and indeed, all 28 study communities in the origin sample had a primary school.

Socio-economic characteristics. The dwellings in origin communities (Table 6) were generally similar to other rural ones throughout the country (compare with data from the census of population and housing (e.g., INE 1993), with roofs generally of metal (zinc) sheeting, and most walls of wood or cement blocks. However, more like the frontier destination homesteads in Petén, 70% of the floors were of packed earth, slightly higher than the 60% national average for rural areas (INE 1993). Roofs in the control communities were better than in the out-migration communities, with 5 of 6 of metal in the former vs. 14 of 22 in the latter; but on the other hand, in every one of the six versus only 13 of 22, dwellings mostly had dirt floors, so housing differences are a wash.

Table 6. Household SES Characteristics

Household SES Characteristics	Percent of Communities with the majority of houses constructed from the following:		Predominantly indigenous	Predominantly Ladino	Petén and Verapaces	Other Regions
Metal Roofs	68%		-	-	-	-
Wood or Cement Walls	75%		-	-	-	-
Earth floors	68%		+	-	+	-
Communities with Electricity	79%		-	+	-	+
Percent cooking with wood	90%		NA	NA	NA	NA
	Median	Mean	-	+	-	+
Landless	80%	70%	-	+	-	+
Percent in Non-agricultural Employment	10%	20%	-	+	-	+
Daily Salary	200	200	+	-	+	-

Source: Interviews with community leaders in 28 communities of migrant origin throughout rural Guatemala.

Electricity is present in 79% of the communities, and roughly the same percentage of households is estimated to receive electricity in their homes in each electrified community. There is no difference between migrant and control communities. Despite the presence of electricity, 90% of the homes cook with wood, the figures being 92% for migrant communities and 85% for the six control communities. It is possible that this contributes to less forest cover and more out-migration in the former, but this is a stretch since the difference is not so large. Unlike the forest-abundant frontier, these more population-dense communities extract their household kindling from a variety of sources. Almost equal proportions of households are reported to acquire kindling from fallow lands, by purchasing it, by "stealing" it from local farms, or legally through pruning trees.

Most rural households in the 28 communities (median of 80%, mean of 67%) have no access to land for farming. The figures are virtually the same for the six control communities. Only a third of the households had access to land, which was very similar to the proportion given by colonists in the SLNP household survey in reference to their previous areas of residence.

In long-settled regions of relatively high rural population density and road access, such as most of the 28 origin sample communities, agriculture was no longer the only source of employment. More than a fifth of the household heads in origin areas work primarily in non-agricultural jobs. This percentage is actually significantly higher in the 6 control communities, where the mean is 34% and the median 33%. This indicates the greater availability of non-agricultural work in those communities, which likely is linked to less out-migration.

The average daily wage was 20 quetzales, or a little under US $3. A basic meal of beans and tortillas sometimes was provided as well. Wages varied only slightly across the sample communities, and averaged five to 10 quetzales (one-fifth to one-third) lower than in the Petén frontier (Carr 2008).

In regards to socio-economic characteristics of migrants from the study communities, most informants said that frontier migrants were of the lower socio-economic standing based on most measures, while US-bound migrants were of the highest socio-economic status. This was explained as being both a product of their ambitions and of the conditions that would enable such a move (financing such a move being costly). Because migration to the US is so high-risk and costly, most migrants to the US have contacts in their intended destination prior to migration. The same is true for migrants to Guatemala City, not so much because of the risk involved but because it is such a populous city comprised largely of migrants. Most migrants to the Petén frontier, on the other hand, did not have friends or family there before migrating. On the other hand, word spread quickly and widely regarding land availability in Petén: Informants described how information on successful frontier colonization would reach origin areas when frontier migrants would return to visit. From such visits, news spread to neighboring communities as well, around much of the country. By the time of the interviews in 1999-2000, however, most informants reported that little or no land remained available for colonization close to a road.

Agriculture. Despite the fact that the majority of farmers are landless, three-quarters work primarily in agriculture, with most renting a small plot or working one in exchange for providing labor on a plantation. These plots range on average from one-half to two hectares and are dominated by maize, the staple food in Guatemala (Table 7).

Table 7. Agricultural and ecological characteristics

	Median	Approximate Mean	Predominantly indigenous	Predominantly Ladino	Petén and Verapaces	Other Regions
Hectares in crops	0.75	1.75	+	-	+	-
Percent of communities in which the average farm will have the following uses:						
Maize as the predominant common crop		85%	+	-	+	-
Communities in which an average farmer may have fallow		20%	+	-	+	-
Communities in which an average farmer may have forestland		15%	+	-	+	-
Communities in which an average farmer may have livestock		15%	-	+	-	+
Percent of communities in which the average farmer employs the following:						
Pesticides		90%	-	+	-	+
Fertilizers		90%	-	+	-	+
Herbicides		90%	-	+	-	+
Velvet Bean		65%	NA	NA	NA	NA
Employs one of the above		100%	-	+	-	+
Percent listing the following as the principal problems with farming:						
Insufficient land		25%	-	+	-	+
Too much rain		20%	-	+	-	+
Pests		18%	-	+	-	+
Lack of land tenure		14%	+	-	+	-
Communities in which the soil has degraded since 1989		90%	-	+	-	+

Source: Interviews with community leaders in 28 communities of migrant origin throughout rural Guatemala.

Due to favorable market access, diverse crops such as sugar cane, coffee, vegetables and plantains are also grown in origin areas. Farmers tend to sell to middlemen who come with large grain trucks and transport the crop to Guatemala City or to local markets. Because the vast majority of farms are tiny (the median is under one hectare), it is uncommon for farmers to have the luxury to let land go fallow, or to maintain precious land in forest that could be used for crop production. Similarly, such small plots are insufficient for maintaining a viable livestock population. In addition, in most communities use of chemical fertilizer, pesticides,

herbicides, and natural fertilizer (velvet bean) is very common, a further indicator of common problems with soil quality and insect pests. In all of the above, there is no evident difference between migrant communities and control communities.

However, there may be some differences in the problems reported by the two groups of communities. First, Table 7 presents the overall figures on the *principal* problems (some reported two) confronted by farmers in each community, as reported by the informants: Overall, the three most common problems, each mentioned by a third of the communities (excluding five not reporting problems) are two involving Mother Nature—pests and too much rain or in one case not enough rain (rainfall varies by location and year, and rainfall was greater than usual in some parts of the study region in the years 1997-99 prior to the survey)—and poor soils—a recurrent theme in most of the origin communities, as was seen above in the discussion of reasons for out-migration. Three communities reported land tenure or lack of land access problems, which has to be a gross understatement given that the vast majority have no land of their own. This perception could be affected by who the respondents are in the community survey--often *alcaldes auxiliares*, who are local political figures who are sometimes the large landlords who own their own land and a lot of land, and are likely to be much less sensitive to the issue. In addition, many farmers who rent or sharecrop have been doing it for generations and accept it as their fate and focus on the problems they have with their *milpa* (corn plot). Finally, the last category indicates that in one community each informant reported lack of credit and lack of market access as the major problem.

In the control communities, 3 of 6 report no significant problem, while two report pests, and two (overlapping) report poor soil quality as the major problems. This contrasts with the migrant communities in which only 2 of 22 report no problems with agriculture, while too much rain is reported by six and too little by one, pests are reported by five, and poor soils or need for fertilizer which the farmers could not afford are reported by five. Thus, the out-migration communities are significantly less likely to report no problems, and more likely to report problems of rainfall and degraded soils. The former could have been temporary, and bad luck compared to the control communities. But the soil degradation problem could be linked to their being much older communities, as their median date of founding was in the 1940's in contrast to the control communities being mostly newer communities founded in 1980, or only about 2 decades before the survey. Therefore, they are much less likely to have used the soil so many years (with insufficient replenishment through fertilizers) as to degrade it, to leach it of nutrients over time. Thus, even though fertilizer use is widespread, most (small, tenant or sharecropper) farmers cannot afford to buy enough fertilizer to sustain soil nutrients (see next subsection below).

The last line in Table 7 indicates the response to the question of whether the soil quality in the community has *declined or not* in the previous decade, with an astounding 87% of the communities reporting it has. But only 2 of 6 of the control communities report this compared to 17 of 21 of the migrant communities, a result consistent with the findings above.

Ecological and Climatological Factors. Because many of the minifundias (small, rented farms) which characterize the origin rural communities are cropped year after year without letting land go fallow and because they are located on land that larger, wealthier farmers deem marginal for their own agricultural investments, soil degradation cumulating over time is a serious problem. Almost every informant in origin villages complained that farmers were continually engaged in a losing battle with land degradation (Table 7). As soil nutrients are mined continually for crop production, soil depletion appears to have outpaced the soils' natural ability to slowly regenerate itself or the limited efforts to apply fertilizers of local farmers.

Virtually all farmers lamented that the soil quality on their plots had been depleted significantly during the previous ten years. And it was generally considered that in each community, whether in the highlands or lowlands, the southeast or the Pacific littoral, virtually all farmers employed some form of nutrient replenishment to compensate for soil erosion and degradation. Because of the continuous cropping due to small farm size, and the predominance of a single crop, maize, pests readily adapt to the maize-rich environment.

Comparing regions, soil impoverishment—and the inability to amend soil fertility with purchased inputs—was the most frequently cited problem in the Verapaces and southern Petén, regions of sharper relief and, therefore, potential for soil erosion. Conversely, the number one problem associated with farming in most of the communities in the Southeast and Pacific Littoral was flooding. Informants commented that out-migration was more common among households affected by flooding or soil degradation, both environmental problems.

8. SUMMARY, DISCUSSION AND FUTURE RESEARCH

As the bulk of remaining tropical forest lies outside the boundaries of current colonist farms, the major potential for further forest conversion in tropical agricultural frontiers in Latin America and elsewhere lies not in the hands of those migrant farmers already living on the frontier but rather in those of future colonists who will migrate to current and new frontiers. The extensive research on land use/cover change (LUCC) at the frontier has rarely considered this issue in relation to the ongoing deforestation. This process is not a *fait accompli*; it should be researched as one of many potential outcomes of families making decisions to migrate from low-productivity areas of origin in an effort to improve their lives. The need for this is a major point of this paper.

Before proceeding to consider policy implications, on the one hand, and limitations of the research and further research needs, on the other, it is useful here to briefly summarize the empirical findings of this paper, focusing on where there are differences between the six control communities and the 22 selected communities characterized by having some out-migrants to the Sierra de Lacandón National Park in the northern Petén *departamento*, the main agricultural frontier in Guatemala. First, data on reported reasons for people leaving found lack of land reported more often in the migration than the control communities. This was supported by data on reported problems with farming in which lack of land, lack of secure land tenure, and soil degradation were more commonly cited in migration than control communities. Climate-related factors were also a factor, with floods and pests reported as more common problems in migration communities. Further, violence had been a factor in disrupting more the migration areas and forcing out-migration in earlier years. Non-agricultural employment opportunities seemed more sought and found as well in the control communities, likely leading to less out-migration. Finally, levels of education appeared higher in the migrant than the control communities, as measured by male literacy and children's primary school attendance. An interpretation of this finding is that aspirations are higher, or economic opportunities better outside the low-income rural origin communities, leading to more out-migration. However, at the level of individuals, those with more education tend to migrate to the USA or Guatemala City, while those who leave these origin communities for the Petén are at the low end of the education ladder, albeit migrating from communities with relatively more education.

Although the empirical results are not generally definitive, due to the methodological limitations of the study (described below), a number of distinct areas for policy interventions can be inferred, with respect to demographic, political-economic, and socio-economic factors, to reduce out-migration from origin communities in Guatemala and, in particular, migration

to the rural-frontier in northern Guatemala. A common denominator in the communities of migration origin was unequal resource access, usually land. For the rural poor, a precious resource is land, whose distribution is particularly skewed in Guatemala (see this paper, above). As discussed in Brazil (Marcoux 1990) and elsewhere (Mörner and Sims 1985; Morrison and May 1989; Castillo 1995; Pichon and Bilsborrow 1999), improving land distribution, securing land ownership, and promoting credit availability for small farmers (vs. large cattle ranchers) in origin areas could improve the welfare of thousands of landless and near-landless farm families and reduce incentives to out-migrate. But land redistribution is not enough. Investing in human capital through improving primary schools and improving access to secondary and vocational schools could improve options for rural youth. However, without better farm as well as non-agricultural employment opportunities in rural towns, more education will only lead to more out-migration. Land is a finite resource; resources associated with non-agricultural job creation are not. One option that may be considered when migrant retention is unfeasible is planned migration that attempts to reconcile agricultural needs with conservation (López-Carr, D., & Marter-Kenyon, J. (2015).

Land resources become scarce not only through land concentration. The greatest *demographic* threat to forest clearing in the Maya Biosphere Reserve is not high fertility among migrant settler farm families there but rather among families in origin areas. This supports previous work of demographics on conditions in areas of migrant origin as underlying causes of out-migration to the forest frontier and resulting deforestation (Heckandon and Mc Kay 1984). As found in much research on land use and forest cover in forest frontier areas (e.g., Carvajal and Geithman 1974; Perez 1985; Root and De Jong 1991; Almeida 1992; Cruz 1992; Ram and Singh 1994; De Jong 1996; Bilsborrow et al. 2004), it is mainly young families that migrate to the frontier. Bilsborrow and Stupp (1997) speculated that high fertility was a factor in out-migration from the Guatemalan highlands during the middle and latter half of the 20th century since it led (through partiable inheritance) to subdivision of farm plots over time, making them ever less economically viable. The data from the earlier 1998-99 household survey conducted by Carr in the SLNP demonstrated that young families with high fertility were the most likely to move to the frontier. Thus, providing and promoting reproductive health services in rural areas could over time reduce pressures on the land, pressures which seemingly affect out-migration.

Were it not for the construction of roads penetrating the Maya Biosphere Reserve in Petén, colonists would not have flooded into the region in the first place. Yet good road access to markets in origin communities could help retain potential rural out-migrants from origin areas. This was reported as a need in several study communities in the survey here. However, poor populations in origin communities can be essentially trapped with little opportunities for livelihood improvement and be pulled by dreams of land ownership in Petén. A question emerging over the past decades is how violence by drug trafficking and organized crime has become an increasingly salient factor for pushing population out of these same areas, as cartels gather more control of the land.

As reported in some studies of Amazonian colonists (Hecht 1983; Schneider 1993; Browder 1997), soil degradation was a factor in the decisions of migrants to leave their places of origin to migrate to the Amazon. Fertilizer subsidies or use of local organic and animal manure fertilizers could alleviate soil nutrient deficiencies. More equitable land distribution would provide many more rural families with viable farms. Promoting intensification of land use and crop rotation would help reduce land degradation in addition to improving yields. Investing in public works—such as potable water delivery, roads, and schools—would improve local living conditions, which could reduce incentives to out-migrate. Expanding small irrigation programs including creation of water storage sites could improve exploitation of water for cultivation.

The limitations of this study constrain representation and generalization of our findings. The main method of data collection based on surveys *at the community level in communities of origin* had not been used previously to study migration, as far as we are aware. It therefore represents a new effort, one which will be improved in future studies. Improvement can be accomplished in various ways, relating to the sample, the questionnaire content, and the use of new technology. First, the sample of communities remains too small for a definitive study. A larger sample of origin communities selected from the outset to represent those with high out-migration in general, high out-migration to Petén, and control communities is desired, at least fifty migrant and fifty control communities. Of course, this would cost much more. The content of the community questionnaire, albeit quite innovative for this study, could have collected specific data on the availability of various types of infrastructure (and since when); data should be collected on the presence of secondary and vocational schools, attendance, and location of nearest if not in the community; more data should be collected on road access and connections/buses to not only the nearest market but to provincial and national capitals; on the physical area of the community, and lands in forests and common lands, and use of them; on land tenure and distribution—numbers of families without land and with land in different size categories; and on non-agricultural employment in the community and other nearby accessible communities.

A third point is that interviews in samples of *households* in origin communities would provide important data that is not as reliable or is not available at all from surveys of community informants. This is true of so many things, such as household size, previous out-migration from specific households and destinations, why the person left, receipt of remittances and approximate amount, household assets including land, land size and tenure, renting and sharecropping land, wage earnings and work away from the farm, etc. Linking migration from households to the household context as well as the community context is the ideal way to study migration decision since they are made at the individual and household levels but in a larger community context (Bilsborrow 1998). A limitation of this approach is that it necessarily cannot collect data from whole households that have left the origin community. With a sufficiently large sample size, it would be possible to do a statistical analysis of the many potential factors in origin communities that affect out-migration in general, and out-migration to Petén, in particular. This is the only way to quantitative compare the relative significance of the various factors that appear to influence out migration, some apparent in this study and others perhaps not so.

Finally, satellite imagery can be classified by land use if combined with ground truthing by fieldworkers using GPS. However, with plots as small as they are in Guatemalan rural communities, the use of imagery to measure land use at the farm household level could require imagery that remains expensive to be practical for a large sample of dispersed rural communities and households.

Despite the conditions in origin study communities, most people did *not* out-migrate, indicating that any one or combination of factors associated with leaving is not necessarily sufficient to spur out-migration. And of those who did, only a minority settled the open forests along Petén's expanding agricultural frontiers. Frontier migration is relatively rare. Yet this rare occurrence is the driving force behind most of the planet's deforestation: colonization of forest frontier areas by migrant farm families and their subsequent clearing of forests for agriculture. The research reported here is a first attempt to understand this phenomenon.

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