



Published in final edited form as:

*Environ Res Lett.* ; 7(4): . doi:10.1088/1748-9326/7/4/045603.

## AGRO-ECOLOGICAL DRIVERS OF RURAL OUT-MIGRATION TO THE MAYA BIOSPHERE RESERVE, GUATEMALA

David López-Carr

Professor, Department of Geography, 4836 Ellison Hall, UC Santa Barbara (UCSB), Santa Barbara, CA 93106-4060, 805-456-2830, <http://www.geog.ucsb.edu/~carr/>

### Abstract

Migration necessarily precedes environmental change in the form of deforestation and soil degradation in tropical agricultural frontiers. But what environmental factors may contribute to these migration streams in the first place? Identifying environmental characteristics related to this process is crucial for understanding how environmental change and migration may form recurrent feedback loops. Further understanding this process could be useful for developing policies to reduce both environmentally induced migration from origin areas and also to palliate significant environmental change unleashed by settler deforestation in destination areas. Evidently, apprehending this holistic process cannot be approached only from the destination since this ignores environmental and other antecedents to rural out-migration. This paper presents data from surveys conducted in areas of high out-migration to the agricultural frontier in northern Guatemala. Results suggest that land scarcity and degradation in origin communities are linked to out-migration in general and to the forest frontier of northern Guatemala in particular.

### Keywords

migration; environmental pushes; conservation; land use and land cover change; degradation; agriculture; frontier settlement; Latin America

## 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. While export agriculture has expanded 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? And what environmental pushes might have been associated with these migration streams? These are questions that must be addressed in order to explain a primary *underlying* demographic and environmental driver of deforestation, rural-frontier migration. In other words, what, if any, are the environmental factors that induce people to migrate from origin communities to the forest frontier, which in turn results in major environmental consequences through agricultural deforestation? Probing this question is not easy; it 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.

Diverse socio-economic, political, and cultural histories in different places across rural Guatemala have ultimately engendered a common denominator of land and income inequalities that have served as migration pushes to the agricultural frontiers of the Maya

Biosphere Reserve (MBR) in Guatemala's vast northern Petén (Carr 2008a). Yet to be examined are the potential agro-ecological changes that may have contributed to outmigration pushes. This paper addresses the how agricultural and environmental dynamics may have potentially contributed to out-migration from diverse rural regions of Guatemala to the agricultural frontiers of the MBR.

A substantial literature has examined migration determinants in regards to origin pushes and destination pulls, drawing on the work of Lee (Lee 1966), Todaro (1969), De Jong and Gardner (1981), Bilsborrow et al. (1984), Massey (1990), White and Lindstrom (2005), and others. But these approaches tend to focus on individual and household factors that influence migration. Relevant also are place-related environmental factors, which may be subsumed under place-related structural factors (Wood 1982), that lead people to leave places of origin.

Inherent in place is the environmental milieu, yet compared to macro and micro economic drivers relatively little is known about environmental out-migration pushes (van der Geest 2011, Radel, Schmook and Mc Candless 2010). Environmental migration pushes are increasingly salient (Hecht 1983; Schneider 1993; Browder 1997; Bilsborrow 2002; Adamo 2010), although empirical evidence remains scant. And crop failures promote migration among vulnerable households regardless of the environmental push (Gray and Mueller 2012). Environmentally induced migration can be spontaneous (de Haan, Brock and Coulibaly 2002) as is often the case with environmental refugees (Myers 2002), or it may be facilitated by the government to promote ecological restoration in the sending area (Wood 2001). Migration remains part of a suite of social processes nested within environmental contexts that ultimately impact household vulnerability (Hunter 2006, Black et al. 2011, McLeman and Hunter 2010, Hunter 2005). Increasingly, environmental vulnerability to migration is part of a global teleconnected system (Adger, Eakin and Winkels 2009). Nevertheless, the household and individual ultimately decide to migrate as highlighted by observations that environmentally hazardous places do necessarily lose more residents through migration compared to other places (Hunter 1998).

Some studies suggest the importance to out-migration 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 increasing scarcity of fuelwood and time to collect fuelwood related to out-migration.

Environment is only as important to a rural farmer as the integrity of their land. Land is key, both its availability to households in terms of amount, location, and quality, security through tenure, and also the availability of common lands to both those who may have land and those without land tenure. In general, the literature has largely concluded that when people have access to land, out-migration decreases (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). But land quality is also important. Soil quality has been found to increase migration but this finding is not universal (Gray 2009a,b; 2011). Further, soil degradation is not always resolved by out-migration, especially when soil conserving labor is lost (Thapa and Yila 2012). Lastly, in some instances farmers may perceive environmental change and soil degradation to be major drivers of local environmental change when global market processes may be equally important (Mbow et al 2008).

This paper examines data from a relatively rare type of data collection to address the question of how ecological processes may have contributed to the migration of households to the northern agricultural frontier of Petén from different areas of rural Guatemala. There has been very little data collection in areas of origin to study why people leave settled rural areas for the relatively scarcely settled frontier, despite this being a fundamental part of the process of explaining the causes of tropical deforestation. Therefore, the research presented here explores data from perhaps the first survey specifically designed and carried out (in 1999 and 2000) in communities of high outmigration to an agricultural colonist frontier in Central America (Carr 2008a). The paper is organized as follows. In the next section I discuss 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 pattern, with a focus on environmental and agro-ecological pushes. A concluding section summarizes the results and discusses their implications for policy and future research.

## METHODS

### 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 (Carr 2008b) who had migrated to and settled in and near the Sierra de Lacandón National Park (SLNP), a core conservation zone of the Maya Biosphere Reserve (MBR) located in the western part of Petén, bordering Mexico (see Map 1). Data were collected from sixteen *municipios* (roughly similar in size and population to counties in the United States) 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 of colonist origin, covering most of Guatemala except the Altiplano or Western highlands (which has had relatively few migrants to Petén), are the Pacific Coast, the South, the East, the Verapaces adjacent to and south of Petén, and Petén itself (see Map 1; in depth case studies indicated as black dots on the map are detailed in Carr 2008a).

*Municipio* selection was based on data from the 1993 census of population on inter-municipal migration (Instituto Nacional de Estadística 1993). The *municipio* is the smallest political unit with census and other data generally coded and available in Guatemala. The *municipio* of La Libertad contained 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.<sup>1</sup> Lastly, among the 16 *municipios* of origin identified from census data, 28 communities of highest outmigration to the SLNP were chosen, drawing on data from the household survey in the SLNP from Carr (2003) on the origins of migrant families in that survey. Two communities were chosen from this selection procedure in 12 of the 16 *municipios*. One was chosen in the remaining 4 *municipios*. A limitation of the methodology should be recognized that since only communities of high out-migration to Petén were examined, comparisons with low-migration communities are not possible.

### Questionnaire Design: Data Collected

Interviews were carried out in 1999 and 2000 with several key informants and community leaders in 28 communities of high out-migration (as determined by Carr's 1998 SLNP data as detailed in Carr, 2003) within the 16 selected *municipios* (Carr 2008a,b). Those interviewed were most often mayors (alcalde auxiliary) or members of the town or community council or development committee (comité de pro mejoramiento), health

promoters, teachers, religious leaders, and heads or members of village committees or organizations.

The semi-structured questionnaire asked informants about their own experience, about the community in general, and probed both typical and extreme cases. Informants were asked about migration to the SLNP, the MBR, and, and to Petén more generally. The main difference among these (nested) destinations is that the SLNP is a recent agricultural frontier with a large portion of all MBR migrants settling there in recent years. The instrument included modules on community history, economics, population, health, migration, geography, and land use and the environment (further details are in Carr 2003 and 2008a). The section on land use and the environment, the longest, inquired about land management and production, about problems, if any, with each crop, and about different types of environmental change and degradation as potential migration pushes, including temperature and precipitation change or anomalies. Each section offered ample opportunities for additional qualitative information and comments, beyond the quantitatively structured questions. The mixed methods employed here build on the valuable combination demonstrated in the first studies of migration from Mexican communities to the USA by Massey et al. (1987). The following section presents results from the analysis of the data for the 16 communities selected for having a high proportionate number of out-migrants to the primary agricultural frontier in Guatemala during the 1990s.

## RESULTS

### Migration Patterns

Approximately 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. More germane to this paper, approximately 10% of the adults (the 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 1). As documented elsewhere (Morrison 1993), permanent out-migration spiked in many communities during the height of the civil war in the 1980s, though out-migration peaked later to areas of more recent settlement, such as the agricultural frontier in Petén.

At least as many permanent migrants from the sample communities settled in Guatemala City as in Petén—despite the sample having been selected on the basis of high outmigration 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. 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).

Most relevant for this particular study are environmental reasons given for why people left their origin community. By far the most commonly cited factor in outmigration was lack of land or degraded land. This was followed by lack of local work opportunities, lack of education or other services, and floods. The next section describes the agro-ecological characteristics of communities in relation to these differential migration patterns in *municipios* of relatively high out-migration to the Petén frontier.

## Agro-ecological Migration Pushes

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 2). 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 remain 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 remain insufficient for maintaining a viable livestock population. In addition, in most communities use of chemical fertilizer, pesticides, herbicides, and natural fertilizer (velvet bean) is heavily applied (Table 2)—a further indicator of common problems with soil quality and insect pests.

Table 2 presents the overall figures on the *principal* problems (some reported two) confronted by farmers, as reported by informants: Overall, the three most common problems, each mentioned by a third of the communities (excluding five not reporting problems) are two involving environmental dynamics—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 prior to the survey)—and poor soils—a recurrent theme as a secondary or tertiary problem expressed in most of the origin communities. Three communities reported land tenure or lack of land access problems yet land tenure was frequently mentioned as a secondary or tertiary problem as the vast majority has no land of their own. This apparent underrepresentation of land access issues 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, often a substantial amount of land, and are likely to be much less sensitive to the issue. In addition, many farmers who rent or sharecrop have been engaged in these activities for generations and accept it as their fate and focus on the problems they have with their *milpa* (corn plot) specifically. Finally, the last category demonstrates that in one community informants reported lack of credit and lack of market access as the major problem.

The last line in Table 2 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 90% of the communities reporting it has. Soil degradation is reported despite communities having been established only since the 1940s among a handful and as recently as the 1980s for others. Thus, even though fertilizer use is widespread, most (small, tenant or sharecropper) farmers typically report being unable to afford to purchase enough fertilizer to sustain soil nutrients. 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. 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. 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. Further, 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, and increasing pesticide application was mentioned frequently (Table 2).

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, enhanced 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 agreed that permanent out-migration was more common among households affected by flooding or soil degradation and that these environmentally induced out-migrants tended to be among the more vulnerable and more likely to settle the agricultural frontier regions—often within or adjacent to the Maya Biosphere Reserve.

## SUMMARY, DISCUSSION AND FUTURE RESEARCH

Data on reported reasons for people leaving found lack of land, lack of secure land tenure, and soil degradation as the most commonly cited migration pushes. Climate-related factors were also a factor, with floods and pests reported as common problems. 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. Understanding drivers of migration to the MBR remain crucial. According to estimates produced by the Guatemalan Statistics Institute (INE), between 2008–2012 Petén grew by 22%, far exceeding the growth of any other Guatemalan departamento. This growth remains concentrated particularly in the top handful of municipios with active agricultural frontiers (<http://www.ine.gob.gt/np/poblacion/index.htm>).

Despite ubiquitous conditions among origin study communities largely propitious for exiting, and despite the communities having been selected in the sample frame for high out-migration to the frontier, most people did *not* out-migrate. Evidently any one or combination of factors associated with leaving is not necessarily sufficient to spur outmigration. And of those who did, only a minority settled the open forests along Petén's expanding agricultural frontiers. Frontier migration remains relatively rare globally. Yet this rare occurrence is the driving force behind much of the planet's deforestation: the colonization of forest frontier areas by migrant farm families and their subsequent clearing of forests for agriculture. The research reported here is an attempt to understand some important environmental antecedents—*vis a vis* migration pushes to the forest frontier—to this phenomenon. Future research may usefully include household interviews in the area of origin nested within community and municipal factors.

## Acknowledgments

I would like to acknowledge the following funding sources that contributed to the data collection and analysis for this paper: National Institutes of Health (NIH), K01 (HD049008), National Science Foundation (NSF) GSS (BCS-0525592), a Fulbright-Hays Fellowship, an Institute for the Study of World Politics Fellowship, Rand Corporation Field Research Grant, Social Science Research Council Fellowship, and a Mellon Foundation Foreign Language and Area Studies Fellowship. I am also grateful to Aracely Martinez who assisted closely in field interviews and led the data entry, and Richard E. Bilsborrow and Thomas M. Whitmore who were invaluable contributors to the conceptual and survey design and in reviewing several earlier drafts of this material.

## REFERENCES

- Adamo, Susana B. Environmental migration and cities in the context of global environmental change. *Current Opinion in Environmental Sustainability*. 2010; 2(3):161–165.
- Adger WN, Eakin H, Winkels A. Nested and teleconnected vulnerabilities to environmental change. *Frontiers in Ecology and the Environment*. 2009; 7:150–157.
- Barbieri AF, Carr DL, Bilsborrow RE. Migration Within the Frontier: The Second Generation Colonization in the Ecuadorian Amazon. *Population Research and Policy Review*. 2009; 28:291–320. [PubMed: 19657471]

- Beauchemin C, Schoumaker B. Migration to Cities in Burkina Faso: Does the Level of Development in Sending Areas Matter? *World Development*. 2005; Vol. 33(No. 7):1129–1152.
- Bilsborrow, RE. Population, Environmental Change, and Security Working Paper No. 2. Ann Arbor and Washington, DC: Population and Environment Fellows Program, University of Michigan and Woodrow Wilson International Center; 2002. Migration, Population Change, and the Rural Environment.
- Bilsborrow, RE.; Oberai, AS.; Standing, G., editors. *Migration Surveys in Low-Income Countries: Guidelines and Questionnaire Design*. London: Croom-Helm; 1984.
- Bilsborrow RE, McDevitt TM, Kossoudji S, Fuller R. The impact of origin community characteristics of rural-urban out-migration in a developing country. *Demography*. 1987 May; 24(2):191–210. [PubMed: 3609405]
- Black R, Adger WN, Arnell NW, Dercon S, Geddes A, Thomas DSG. The effect of environmental change on human migration. *Global Environmental Change-Human and Policy Dimensions*. 2011; 21:S3–S11.
- Bravo-ureta BE, Quiroga RE, Brea JA. Migration decisions, agrarian structure and gender: the case of Ecuador. *J Dev Areas* 1996 July. 1996; 30(4):463–476.
- Browder, J. *Rainforest Cities*. New York: Columbia University Press; 1997.
- Carr, DL. 10 Tiempos de America: Revista de Historia, Cultura y Territorio. Centro de Investigaciones de America Latina (CIAL), Universitat Jaume I; 2003. Migracion rural-rural y deforestacion en Guatemala: Método de Entrevistas; p. 19-27.
- Carr DL. Population, land use, and deforestation in the Sierra de Lacandón National Park, Petén, Guatemala. *The Professional Geographer*. 2005; 57(2):157–168.
- Carr DL. Migration to the Maya Biosphere Reserve, Guatemala: Why place matters. *Human Organization*. 2008a; 67(1):37–48. [PubMed: 19657470]
- Carr DL. Farm households and land use in a core conservation zone of the Maya Biosphere Reserve, Guatemala. *Human Ecology*. 2008b; 36(2):231–248.
- Becker CM, Morrison Andrew. Observational Equivalence in the Modeling of African Labor Markets and Rural-Urban Migration. *World Development*. 1993; 21(4)
- de Haan A, Brock K, Coulibaly N. Migration, Livelihoods and Institutions: Contrasting Patterns of Migration in Mali. *Journal of Development Studies*. 2002; 38:37–58.
- de Sherbinin A, Carr D, Cassels S, Jiang L. Population and Environment. *Annual Review of Environment and Resources*. 2007 Nov. Vol. 32:345–373. 2007.
- De Jong, Gordon F.; Gardner, Robert W. *Migration decision making: Multidisciplinary approaches to microlevel studies in developed and developing countries*. 1981 (ISBN 0080263054).
- De Jong, W.; Winsten, JA. Unpublished paper. Harvard School of Public Health; 1996. The Use of the Mass Media to Communicate Public Service Messages: Lessons Learned from Past Campaigns.
- Davis, J.; López-Carr, D. The Effects of Migrant Remittances on Consumption in Highland Guatemala; Proceedings of the European Population Conference; September 1–4, 2010; Vienna, Austria. 2010.
- Ezra M, Kiros G-E. Rural Out-migration in the Drought Prone Areas of Ethiopia: A Multilevel Analysis. *International Migration Review*. 2001; 35:749–771. [PubMed: 19186413]
- Findley SE. Does drought increase migration? A study of rural migration from Mali during the 1983–1985 drought. *International Migration Review*. 1994; 28:539–553. [PubMed: 12345794]
- Geist, Helmut J.; Lambin, Eric F. What drives Tropical Deforestation? A meta-analysis of proximate and underlying causes of deforestation based on subnational case study evidence. *LUCC Report Series No. 4*. 2001
- Geist HJ, Lambin EE. Proximate causes and underlying driving forces of tropical deforestation. *BioScience*. 2002; 52(2):143–150.
- Gray CL. Rural out-migration and smallholder agriculture in southern Equadorian Andes. *Population and Environment*. 2009a; 30(4–5):193–217.
- Gray CL. Environment, Land, and Rural Out-migration in the Southern Ecuadorian Andes. *World Development*. 2009b; 37(2):457–468.

- Gray CL. Soil Quality and Human Migration in Kenya and Uganda. *Global Environmental Change*. 2011; 21(2):421–430. [PubMed: 22016577]
- Gray CL, Valerie Mueller. Natural Disaster and Population Mobility in Bangladesh. *PNAS*. 2012; 109(16):6000–6005. [PubMed: 22474361]
- Hecht, S. Cattle Ranching in the Eastern Amazon: Environmental and Social Implications. In: Moran, EF., editor. *The Dilemma of Amazonian Development*. Boulder: Westview Press; 1983. p. 155-188.
- Henry S, Schoumaker B, Beauchemin C. The impact of rainfall on the first out-migration: A multi-level event-history analysis in Burkina Faso. *Population and Environment*. 2004; 25(2):423–460.
- Hunter LM. The association between environmental risk and internal migration flows. *Popul Environ*. 1998; 19:247–277.
- Hunter LM. Migration and environmental hazards. *Popul Environ*. 2005; 26:273–302. [PubMed: 21886366]
- Hunter LM. Household strategies in the face of resource scarcity in coastal Ghana: are they associated with development priorities? *Population Research and Policy Review*. 2006; 25:157–174. [PubMed: 21874078]
- Instituto Nacional de Estadística. Encuesta Nacional de Ingresos y Gastos. Guatemala: 1993.
- Instituto Nacional de Estadística. [accessed October 26, 2012] Proyección de Población por municipio. 2008–2020. <http://www.ine.gov.gt/np/poblacion/index.htm>
- Johnston, B.; Clark, W. *Redesigning rural development: A strategic perspective*. Baltimore: Johns Hopkins University Press; 1982.
- Lee, Everett S. A Theory of Migration. *Demography*. 1966; Vol. 3(no. 1):47–57.
- Marcoux A. Urban and rural populations and labour-force structures: current patterns and their implications. *Popul Bull UN*. 1990; 1990(29):32–38. [PubMed: 12343057]
- Massey DS. The Ethnosurvey in Theory and Practice. *International Migration Review*. 1987; Vol. 21(No. 4):1498–1522. Special Issue: Measuring International Migration: Theory and Practice (Winter, 1987). [PubMed: 12280921]
- Massey DS. Social Structure, household strategies and the cumulative causation of migration. *Popul Index*. 1990 Spring;56(1):3–26. [PubMed: 12316385]
- McLeman RA, Hunter LM. Migration in the context of vulnerability and adaptation to climate change: insights from analogues. *Wiley Interdisciplinary Reviews-Climate Change*. 2010; 1:450–461. [PubMed: 22022342]
- Mc Nicoll, G.; Cain, M. Institutional effects on rural economic and demographic change. In: Mc Nicoll, G.; Cain, M., editors. *Rural development and population: Institutions and policy*. New York: Oxford University Press; 1990.
- Mehta SR. Migration as a phenomenon and process of population change. *Popul Geogr*. 1987. 1987 Jun-Dec;9(1–2):16–24.
- Mbow, Cheikh; Mertz, O.; Diouf, A.; Rasmussen, K.; Reennberg, A. The history of environmental change and adaptation in eastern Saloum–Senegal—Driving forces and perceptions. *Global and Planetary Change*. 2008; 64(3–4):210–221.
- Thapa GB, Yila OM. Farmers' land management practices and status of agricultural land in the Jos Plateau, Nigeria. *Land Degradation and Development*. 2012; 23:263–277.
- Myers N. Environmental refugees: a growing phenomenon of the 21st century. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*. 2002; 357:609–613.
- Radel C, Schmook B, McCandless S. Environment, transnational labor migration, and gender: case studies from southern Yucatan, Mexico and Vermont, USA. *Population and Environment*. 2010; 32:177–197.
- Schneider R. Land Abandonment, property rights, and agricultural sustainability in the Amazon. LATEN Dissemination note #3 of The World Bank Latin American Technical Department Environmental Division. 1993
- Shaw, PR. *Migration Theory and Fact (Bibliography Series, No 5)*. Philadelphia: Regional Science Research Institute; 1988.



- Shrestha, Sundar S.; Bhandari, Prem. Environmental Security and labor migration in Nepal. *Population & Environment*. 2007; Vol:29(no. 1):25–38.
- Todaro MP. A Model of Labor Migration and Urban Unemployment in Less Developed Countries. *American Economic Review*. 1969; 59(1):138–48.
- van der Geest K. North-South Migration in Ghana: What Role for the Environment? *International Migration*. 2011; 49:e69–e94.
- Van der Geest K, Vrieling A, Dietz T. Migration and environment in Ghana: a cross-district analysis of human mobility and vegetation dynamics. *Environment and Urbanization*. 2010; 22:107–123.
- White, MJ.; Lindstrom, DP. Internal migration. In: Poston, DL.; Micklin, M., editors. *Handbook of population*. New York: Kluwer Press; 2005.
- Wood CH. Equilibrium and historical-structural perspectives on migration. *Int Migr Rev*. 1982 Summer;16(2):298–319. [PubMed: 12312171]
- Wood WB. Ecomigration: linkages between environmental change and migration. *Global migrants, global refugees: Problems and solutions*. 2001; 42:61.
- World Bank. *Forest Sector Review*. Washington DC: The World Bank; 1991.



- Selected case study municipalities
- Sample municipalities of migrant origin to the SLNP

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

Table 1

<b>Permanent Migration</b>		
<b>Percent of adults permanently out-migrating from 1989 to 1999</b>		<b>Mean</b>
Men		10%
Women		10%
<b>Principal Destinations</b>	<b>Primary employment</b>	
Guatemala City	Factory or Service worker	35%
Peten	Acquire Land for Farming	35%
USA	Factory, Service, or Agricultural work	10%
Other	Plantation laborer	10%
<b>Principal pushes/pulls</b>		
Work		35%
Land		30%
Improve living standard/education		20%
Natural disasters/Env. degradation		10%
<b>Remittances</b>	<b>From migrants to the following</b>	<b>Proportion sending</b>
	USA	Almost all
	Guatemala City	Some
	Peten	None

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

Table 2

Agro-ecological characteristics as Migration Pushes	Median	Mean	Predominantly indigenous	Predominantly Ladino	Petén and Verapaces	Other Regions
<b>Hectares in crops</b>	0.75	1.75	+	-	+	-
<b>Percent of communities in which the average farm will have the following uses:</b>						
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%	-	+	-	+
<b>Percent of communities in which the average farmer employs the following:</b>						
Pesticides		90%	-	+	-	+
Fertilizers		90%	-	+	-	+
Herbicides		90%	-	+	-	+
Velvet Bean		65%	NA	NA	NA	NA
Employs one of the above		100%	-	+	-	+
<b>Percent listing the following as the principal problems with farming:</b>						
Insufficient land		25%	-	+	-	+
Too much rain		20%	-	+	-	+
Pests		18%	-	+	-	+
Lack of land tenure		14%	+	-	+	-
<b>Communities in which the soil has degraded since 1989</b>		90%	-	+	-	+

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