Male Transnational Migration and its Linkages to Land-Use Change in a Southern Campeche Ejido

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Abstract
This paper describes findings of a case study examining linkages between emerging transnational migration patterns and land-use transformations in an *ejido* in the southern part of Mexico's Campeche state. Qualitative data were derived via in-depth interviews of a stratified random sample of 26 households. The ejido's experience illustrates the linkages between migration and land-use change at an early stage in a community's migration experience. Prior cash cropping of chili, leading to accumulation of relative wealth for certain households, facilitated the initiation of migration, while recent chili cultivation failures have motivated it. Early migration, in turn, is associated with an increase in investment in certain agricultural inputs and a decrease in the rate of chili cultivation, with implications for deforestation and forest recovery.
Key words**:** *transnational migration, land use change, agricultural change, chili cultivation*

Resumen
El presente trabajo examina la relación entre la creciente emigración transnacional y los cambios de uso del suelo en un ejido en el Sur de Campeche, México. Los resultados se basan en un estudio de caso que incluyó, entre otros, entrevistas de profundidad a 26 unidades domesticas seleccionadas a través de una muestra aleatoria estratificada. El estudio ilustra la relación entre migración y cambios de uso del suelo en una etapa temprana de la experiencia de migración de un ejido. El incremento de ingresos provocado por el cultivo comercial de chile facilitó el inicio de la migración, mientras que las mermas registradas en los últimos años fueron el detonante para la misma. El impacto de la migración en su fase inicial se encuentra en un incremento de inversión en ciertos insumos agrícolas y en la reducción de las tasas de cultivo de chile, con implicaciones para la deforestación y la recuperación del bosque tropical.
Palabras clave: *migración transnacional, cambios de uso del suelo, cambios en la agricultura, cultivo de chile*

The migration context

A large body of research has been directed to understanding transnational migration's demographic, cultural and socioeconomic impacts on households and sending communities (e.g. Cohen 2004, Sana and Massey 2005) and on the emergence of migration-based livelihoods (e.g. Sorensen and Olwig 2002). Less attention has been paid to questions of accompanying land-use changes in these sending communities, although a number of geographers have turned attention in this direction (*e.g.* Jokisch 2002, Mc-

Kay 2005, Taylor et al. 2005). Even less work has been carried out on these changes in tropical forest and development frontiers. These questions are increasingly important, as new kinds and levels of migration are being stimulated by forces of globalization and neoliberalization, with considerable potential impact on environments, including tropical forests. Migration from Mexico to the U.S. is a prime example. This movement is not a new phenomenon; what is new is the growing penetration of this phenomenon to the farthest reaches and former agricultural frontiers of developing countries (McSweeney and Jokisch 2007). In Mexico, this includes the southern part of Campeche State and the larger southern Yucatán (SY)[1] peninsular region, where farming communities sit within or border the largest remaining contiguous tropical forest tract in Mesoamerica (Figure 1).

Only since the end of the 1990s has transnational migration as a household livelihood strategy come to Mexico's SY (Schmook and Radel 2004), which until recently was a region of in-migration from elsewhere in Mexico. A few (mostly younger) people have long migrated to the U.S. and other locations in Mexico for various reasons, but since the turn of the millennium outmigration has become an important phenomenon, particularly from the ejidal sector,[2] which dominates the region. Migrants travel from their homes to engage in wage labor for varying periods of time in the U.S. before returning home. As has been found elsewhere in Mexico, these human flows reflect a shift in farming household strategies, from living solely on agricultural products and monetary income generated on their farms to combining agriculture and off-farm incomes (including incomes generated in distant locations). In the SY, this migration began after the region incurred significant deforestation as an outcome of agricultural activities and after the international conservation community identified the region as a tropical deforestation "hot spot" (Achard et al. 1997). Various perspectives on local impacts of these flows have been explored for rural communities in Mexico by geographers and others (*e.g.* Cohen 2004, Conway and Cohen 1998, Durand et al. 1996, Mutersbaugh 2002), but rarely with an eye towards forest impacts (the exception is Klooster 2003).

Many of the ejidos involved in such patterns of migration have land bordering on or crossing into the Calakmul Biosphere Reserve (723,185 ha), which protects Mesoamerica's largest remaining tract of seasonal tropical forest. Until recently the region witnessed significant forest losses (Turner et al. 2004). The research reported here focuses on a single case study ejido with growing migration numbers, analyzing preliminary evidence for the emergence of transnational migration as a component in a mixed livelihood strategy, linked to local changes in land use via agricultural investment and cultivation. Migration emerged and evolved in this ejido as a strategy in concert with the conversion of forest lands to cleared fields for cash cropping of jalapeño chili peppers.

First came a phase of chili-cropping success, with deforestation, agricultural intensification, and increasing numbers of farmers opting to grow chili as they observed the financial successes of their neighbors. This wealth-building phase escalated deforestation but also provided some men with the money they needed to travel to the U.S., with ambitions of further increasing their wealth. In more recent years, chili cultivation, which has always been risky, has become even more risky with higher rates of failure for local farmers due to factors including negative weather events, pests, and low farm-gate prices. This has led to increasing numbers of men choosing to migrate, leading, in turn, to decreased chili production yet continued investment in agriculture.

Transnational migration and impacts on agriculture and land use in sending communities

Two bodies of research examine sending community impacts—one focused on

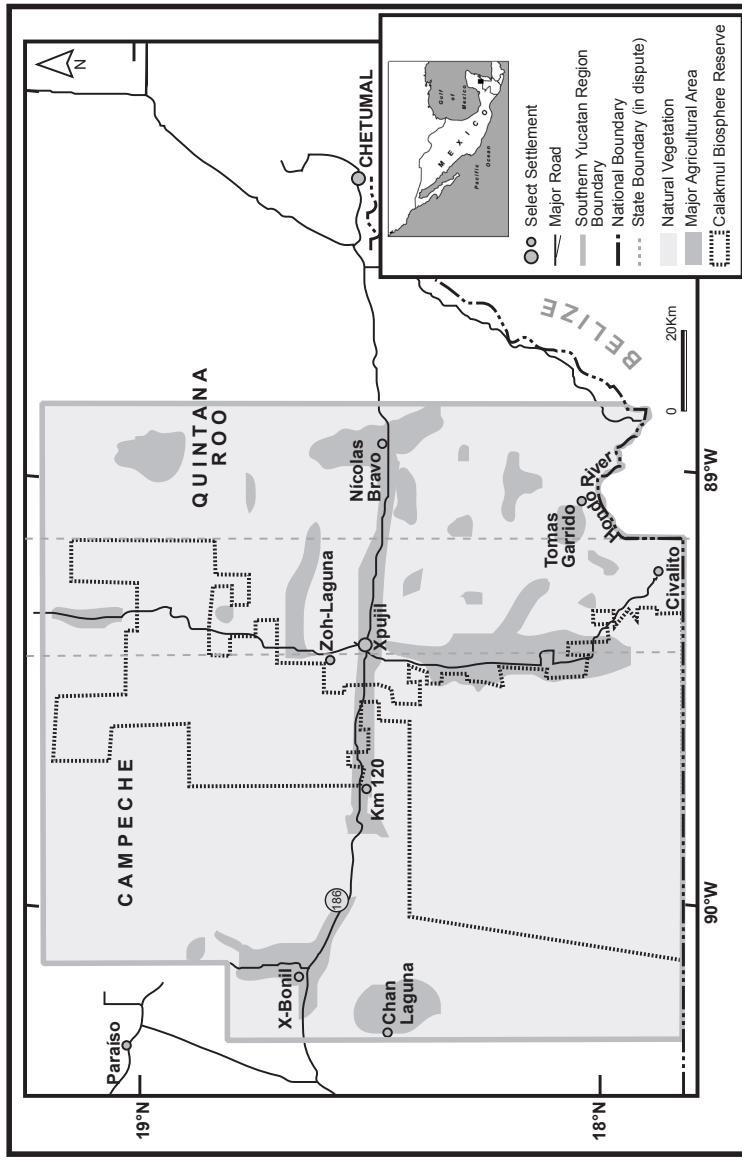

Figure 1: The Southern Yucatan (SY) Region (adapted from Turner et al. 2004).

demographic, economic, social, and cultural changes (Basok 2000, Cohen 2004, Durand et al. 1996, Sana and Massey 2005), and another focused on land use and environmental changes (*e.g.* Hecht et al. 2006, Jokisch 2002, Rudel et al. 2002). These two bodies intersect within studies of the agricultural sector. Previous studies on migration's impacts on agriculture viewed the question primarily through an economic lens, prioritizing questions of labor availability and agricultural productivity (Black 1993, Rozelle et al. 1999, Taylor and Wyatt 1996). Linkages between migration (and accompanying use of migration earnings) and land-use, landscape, and environmental changes are now being examined by geographers and others (Hostettler 2007, McKay 2005, Taylor et al. 2005), and it is to this growing body of research that we aim to contribute.

Our study also examines the 'productiveness' of migration earnings within the agricultural sector, speaking to the larger migration literature on migration and community development. Research on transnational migration's impact on sending-community development has primarily emphasized the role of migration earnings sent or carried back to the migrants' communities of origin, and much of the case study work has taken place in Latin America and the Caribbean. Researchers tend to agree that transnational migration and earnings flows improve living standards of migrants and their immediate families, and numerous case studies have found that these earnings are spent primarily on household consumption and housing as opposed to productive investments (Basok 2000, Dinerman 1982, Wood and McCoy 1985). This does not preclude remittance use for investment purposes under the right circumstances, as Sana and Massey (2005) found in recent work in Mexico. De Haas (2005) argues that in fact the idea remittances are spent mainly on conspicuous consumption and non-productive investments is a myth, founded on "a rather poor empirical and analytical basis" (p. 1274): Migrant households often are more likely to invest in productive enterprises than are non-migrant households (de Haas 2005, Taylor et al. 1996).

Early research argued that migration led to economic dependence and stagnation in the sending communities (*e.g.* Mines and de Janvry 1982, Reichert 1981). However, review articles by Durand and Massey (1992) and Jones (1998) argued that the impact of migration depends in large part on the circumstances of the communities themselves. In a study of 30 Mexican communities, Durand and colleagues (1996) found various community factors for the productive investment of migration earnings to include the status of the sending community as an ejido. They argue that status as an ejido "…substantially increases the odds of remitting" (p. 255) for productive investment as ejidal land is available to poor households but without the means of productive investment in that land.

Cohen has argued that understanding migration requires understanding decision-making embedded in the household (Cohen 2001, 2004). Migration realities and outcomes vary among communities, among households, and as households grow over time (Cohen 2005, Massey et al. 1998). Thus, Cohen and colleagues (2005) argue for depolarizing the debate about migration as good or bad for communities, by arguing that migration is a response of individuals and households to perceived and real opportunities and constraints. "Such an approach recognizes that remittances cannot resolve social inequalities, nor do remittances necessarily lead to growth, but at the same time acknowledges that migrants may have few alternatives to sojourns" (Cohen 2005: 89). Circular migration emerges as one way for individuals and households to pursue a livelihood in rural developing world spaces (Bebbington 2000), especially those places with scarce wage opportunities. With such migration, households continue to diversify livelihood strategies, with many of these strategies taking place locally, including in agriculture.

Literature examining the impact of transnational migration on land use, agriculture, and environments has likewise been divided: Some researchers have observed that

labor loss leads to agricultural deterioration, loss of production, and/or land abandonment (Black 1993, Garcia-Barrios and Garcia-Barrios 1990, Gisbert et al. 1994, López et al. 2006, Rozelle et al. 1999), while a few have argued that migration earnings actually can increase agricultural investment (*e.g.* Taylor and Wyatt 1996). Many researchers have found that the majority of remittances are not spent on agricultural investment (Mines and de Janvry 1982, Wood and McCoy 1985), and recently, Aide and Grau (2004) argued that across Latin America rising rates of migration are leading to the abandonment of agriculturally marginal lands and the recovery of rural ecosystems. Jokisch (2002), who reviews the debate on migration's impact on agriculture, found neither position to be entirely true in the highlands of Ecuador. Cultivation patterns were unaffected by migration, with subsistence production continuing as a risk-averse economic and cultural activity but with little investment into agriculture due to its poor return.

In other regions, researchers have found evidence of changes in rural land use and farming patterns, with associated environmental implications. In Mexico, Mines and de Janvry (1982) found transnational migration to be associated with a shift from staple crop production to low productivity cattle-raising, with traditional maize cultivation maintained by a segment of the community. Over the last couple of decades, the hypothesis that migration, especially circular transnational migration, will lead to expanded pasture and cattle production has been a common one, and has been found to be true in various places. Reichert (1981) found increased conversion of land to pasture in Central Mexico; Georges (1990) documented pasture expansion in the Caribbean; and more recently, Taylor and colleagues (2005) found transnational migration leading to increased clearing of forests for pastures in the lowlands of northwestern Guatemala.

Other types of impacts on agriculture and environments have been documented. In Oaxaca, Mexico, Garcia-Barrios and Garcia-Barrios (1990) found that outmigration resulted in local labor shortages and weakened the "indigenous institutions that regulate collective action in agriculture," leading to both stagnation of agricultural productivity and environmental deterioration. Others have argued that outmigration has led to fewer people and lower rates of soil erosion (Preston et al. 1997), or decreased deforestation (Klooster 2003, Rudel et al. 2002) with decreased clearing and increased areas of secondary growth, perhaps as labor becomes more scarce and expensive (Jokisch and Lair 2002). In El Salvador, Hecht and colleagues (2006) found remittance receipts, in combination with other factors, to be associated with agricultural contraction and forest recovery. Outmigration and its impact on land use and agriculture is increasingly relevant to our understanding and prediction of forest recoveries in developing countries. Elsewhere, we review the literature on forest transition theory and the relevance of globalizing households and new migration patterns to this theory (Schmook and Radel 2008 forthcoming).

The case study ejido: Nueva Esperanza

In order to understand emerging transnational migration behavior and early land-use impacts in the SY, a single ejido was selected as a pilot case study, with the intention of expanding research in the future. Prior extended research in the region and in Nueva Esperanza[3] by the authors identified this ejido as one experiencing a surge in the number of men undertaking short migratory trips to the U.S., leaving wives and children behind. In 2002 fieldwork over a 12-month period in the field, the first author interviewed 50 randomly-selected ejidal women to examine the relationship between conservation projects, women's community-based groups, and farming practices (Radel 2005). Nine of the 50 households had an absent husband in the U.S, and an additional five households had an adult son there. The 2002 fieldwork collected data on household demographics, wealth indicators, cultivation, and farming practices.

In 2004, the second author conducted another set of in-depth, semi-structured interviews with the women from 26 of these original 50 households, to pursue further questions related to migration.[4] These 26 households were selected as follows: The researchers requested interviews with women from all 14 households with either a husband or son in the U.S. in 2002, but only 10 of these women agreed to be interviewed. The remaining 16 households were selected at random from the 2002 50-household sample. Of these 16 households that were non-migrant in 2002, six had become migrant households by the second set of interviews in 2004. For the purposes of this study, a household with *any* member migrating to the U.S. is defined as a migrant household, as long as the other resident members of the household still consider the migrant a household member. Those households with migrating husbands[5] versus those with migrating sons (who have not yet formed their own households) were assessed separately to address the direct cultivation effect, if any, of having a male head-of-household absent during a cultivation season. In Nueva Esperanza adult sons living with their parents usually cultivate their own fields, primarily of chili, to earn their own money separate from their parents.

The 2004 interviews specifically explored the potential causes and effects of transnational migration in the community, particularly the links between migration and land use. Data were collected in three key areas—household wealth, agricultural investment, and cultivation of maize and chili. Additional qualitative information was collected from those households with a migrant head, through discussions with the women (and with their husbands, if in town) to fill in details on the migration trip itself, the husband's motivation for leaving to the U.S., any previous employment in the local region, the financing of the trip, the intended use of migration earnings, cultivation of chili during the husband's absence, and future household cultivation and land-use plans.

We employed univariate statistical analyses to compare the 26 migrant and non-migrant households that were interviewed in both 2002 and 2004. Unfortunately, this stratified sample is small, due to the nature of sample selection from the original 2002 random 50-household sample and the recent emergence of migration in Nueva Esperanza. In our analysis of categorical data, we employed Fisher's exact test to assess statistical significance, as this test is designed specifically for use with small samples. Importantly, statistical results are bolstered by qualitative findings from the open-ended interview questions and from numerous conversations on the topic with individuals in Nueva Esperanza over the last decade.

Regional description: emergence of transnational migration in the SY

Nueva Esperanza is located in the broader SY region—a region of contrasting ambitions in which biodiversity and forest conservation has been juxtaposed with agricultural development over the last three decades. The ejido is specifically located within the municipality of Calakmul, which surrounds the Calakmul Biosphere Reserve. Today the Calakmul municipality is home to over 23,115 people in more than 80 ejidos and small settlements (INEGI 2001).

Local households require cash to finance education of children, cover medical expenses, improve house structures, and provide basic household necessities such as oil and sugar. Previous to and during the 1990s, off-farm work to supplement semi-subsistence production was widely available locally through the restoration work of Mayan archeological sites in the region and through the construction of municipal buildings with the 1996 establishment of Xpujil as the new municipal capital of Calakmul. Most of these opportunities ended in 2000 with the completion of the various construction and restoration projects.[6] Many residents now perceive temporary migration as an important

means to access jobs (and thereby generate additional income) to improve the viability of their lives in the SY.

Prior to 2000, Mexico's National Population Council (CONAPO) ranked Calakmul municipality and Campeche state[7] as having very low outmigration, in comparison to many other Mexican states (CONAPO 2001). This situation has changed dramatically in recent years, and the SY region is experiencing a sudden growth of outmigration, including irregular circular migration (Schmook and Radel 2004). At this early stage in the establishment of transnational migration as a common livelihood strategy, a "culture of migration" *per se*, as Cohen (2004) explores in Oaxaca, cannot be identified in the SY. Neither can the term "transnational peasant" (Kearney 1996, Kyle 2000) be applied accurately, despite the increasing number of households establishing direct linkages to distant U.S. economies. What is possible to identify at this early stage of migration is its normalization. It is no longer unusual, or particularly remarkable, for individuals to travel back and forth from the forests of rural southern Campeche to the U.S.

At the same time, the SY region has experienced a minor resurgence of forest growth, beginning in the mid-1990s. Vester and others (2007), through satellite imagery analysis, note that secondary vegetation in the region is increasing and deforestation rates are decreasing since 1995. Between 1987 and 1995, the region experienced a 0.4% annual rate of deforestation. In contrast, between 1995 and 2000 these trends shifted dramatically, generating a decline in total agricultural and secondary vegetation and a 0.1% annual rate of forest recovery. The authors indicate more frequent use of previously cleared land as a likely cause of the decreasing deforestation and forest recovery observed in the region. This amplifies the question of whether the increasing rates of transnational migration from the region will contribute to forest recovery so far observed, with households either moving out of agricultural production or intensifying production on smaller parcels through the investment of migration earnings; or will increasing rates of outmigration reverse or stop this recovery, with conversion of agricultural production to more extensive land uses (possibly pastures) and increased pressure on forests.

Local transformations in Nueva Esperanza

The case study ejido, Nueva Esperanza, is located approximately twenty km from Xpujil, the municipal seat of Calakmul. It is relatively large, with a territory of approximately 5,000 ha (Klepeis 2000), 97 *ejidatarios* (those individuals with ejidal land rights), roughly 130 households, and a population of almost 600 people (INEGI 2001). The community was formed primarily by immigrants from the states of Chiapas and Tabasco during the 1970s. The population continued to grow through the 1980s and 1990s, with new immigrants attracted by the potential opportunities of chili cultivation, due to relatively deeper and more fertile soils compared to the rest of the region.

Most individual ejidatarios have 40 ha of land, on which cultivation is of a swidden character, although this practice is mixed with disking and use of fertilizers and pesticides for chili. Unreliable rainfall and pest and disease infestations keep production levels low. In addition, agricultural commodity markets in the region are poorly developed and controlled by middlemen. As a result, relying on cultivation as a primary livelihood strategy is risky, especially for chili. Households require other sources of income to supplement agricultural production and subsidize rural livelihoods, as has been found elsewhere in the Yucatán peninsula (Gurri and Moran 2002) and Mexico (Kearney 1996, Massey et al. 1998). The growth in mixed livelihood strategies in Nueva Esperanza, combining smallholder agriculture and off-farm incomes, corresponds with a current overall tendency in rural Mexico. Neoliberal reforms provoking the withdrawal of the state from the primary sector, including removal of price guarantees for maize and other

basic staples at the beginning of the 1990s and elimination of agricultural input subsidies, have further accelerated this phenomenon (Humphries 1993, Yúñez-Naude and Barceinas Paredes 2004).

Many households have no formal access to land (only 58 percent of households interviewed had a member with ejidal land rights), and the number of these households is increasing as the sons and daughters of the early ejidatarios grow up and form their own households. All potential ejidal land in the region has been partitioned and the age of new ejidal land grants ended in 1994 with changes to Article 27 setting the end to conversion of state-owned land into ejidal land. These "landless" households can, and frequently do, borrow land to farm, but land as an asset is limited. Sons remaining in the ejidos are still hoping to become ejidatarios, primarily by inheriting from their fathers. Some sale transfers of land occur, but purchase of land requires cash, which for most is scarce.

State financial transfers, particularly OPORTUNIDADES and PROCAMPO,[8] and the sale of chili are the two most important sources of cash inflow to the community.[9] In the early years of Nueva Esperanza's chili cultivation, some households succeeded in accumulating resources, as evidenced by a relatively high number of tractors and vehicles in the ejido, in contrast to a majority of other ejidos in the region. A good year's chili harvest could bring enough earnings to purchase a truck.[10] This truck became a form of savings, in a region of Mexico with no banking infrastructure, which could later be liquidated to finance a first trip to the U.S. In recent years, however, chili has received a disappointingly low price from middlemen (*coyotes*), with heavy price fluctuations between the years, often barely or not even covering the associated production costs of necessary chemical inputs (Keys 2004a). Although chili cultivation had become widespread in the SY and in Nueva Esperanza by the late 1990s, many farmers have since abandoned chili cultivation. Schmook (2008) found in her research in the SY that 56% of farmers cultivated chili in 1997. By 2003, only 35% did so ($p= 0.00$).

The community in general and most households remain poor by both international and Mexican standards. Most homes are exceedingly humble, constructed of rough wooden boards—many with dirt floors or only a single room with a concrete slab floor. Nonetheless, Nueva Esperanza is developing into an epicenter of new transnational migration patterns in the region. The growth in migration has been facilitated by the successes, and motivated by the more recent disappointments, of chili cultivation.

Nueva Esperanza's lands have experienced considerable transformation in land cover since the establishment of the ejido. Our analysis of land cover change, based on classification maps generated from 1987, 1995 and 2000 Landsat TM and ETM imagery,[11] found that over the last two decades, changes in ejido lands mirror overall land cover changes in the wider region: Deforestation rates and increase in agricultural land were high in the years between 1987 and 1995, but between 1995 and 2000 there was a new trend of forest recovery. In particular, Nueva Esperanza is experiencing a recovery of older secondary vegetation as early secondary vegetation (less than six years old) is left for regeneration instead of being re-cleared. Secondary vegetation of more than 20-25 years has recovered several species which are not present in early secondary vegetation, and if this older secondary vegetation is not cut down again it has a good chance at coming close in species composition to old growth forests (Lawrence et al. 1998, Lawrence et al. 2005, Pérez-Salicrup 2004).

If parcels of migrant households experience decreased cultivation, or intensified cultivation on smaller plots through disking, this trend of regeneration of secondary vegetation will be amplified, with a return to old growth forests. This, in turn, will help maintain species diversity and enrich the local mosaic of agricul-

ture, secondary vegetation and old growth forest. In addition, if migrants decrease cultivation of chili, the result will be decreased introduction of chemical pesticides and fertilizers into the local ecosystem. If, on the other hand, migrants invest in creation and expansion of pasture land, this will occur at the expense of forest recovery. Thus, the land use and agricultural investments of migrant households carry considerable significance for incipient local forest recovery and larger ecosystem health.

Transnational migration and its linkages to chili production

The increased rate of transnational migration from 2002 to 2004 found among the interviewed households mirrors an overall growth in U.S. migration from the ejido. As of January 2004, 76 community members were living in the U.S. During the 2004 field research, on 1 May 2004, an additional group of 20, including four women, left Nueva Esperanza, followed by 10 more individuals only eight days later, most of them without papers authorizing their entry into the U.S. At present two primary types of migrants have emerged in Nueva Esperanza, with potentially different implications for land use change: (1) younger single men who have yet to establish their own households, and (2) married men, many of whom hold ejidal land rights and who leave behind wives and young children. The migration of each group has its own implications for household wellbeing and land-use outcomes. Table 1 outlines some basic characteristics of the migrant and the non-migrant households. Data on household characteristics from the 2002 interviews are employed so as to better avoid confounding conditions for and enablers of migration with household effects from migration events. For almost all migrant households, the 2002 data effectively capture household characteristics prior to any earnings effects from migration.

Our findings from the interviews clarify the reasons for the strong emergence of transnational migration in Nueva Esperanza at this time. First, migration has become a *relatively desirable* livelihood strategy. Local land tenure, agricultural production, and marketing conditions are leading to low income expectations for agricultural endeavors, especially from the cultivation of the primary local cash crop, chili. These low expectations combine with a lack of economic opportunities outside agriculture both in the ejido and in the region, with the result that households perceive few alternatives to exist for cash generation. One woman described her husband's decision to migrate:

> In the past, one could harvest a lot of chili…but when my husband migrated the first time to the U.S. it was because there wasn't enough money to build the house. … The money that he had invested in chili cultivation, he was losing the capital bit by bit, until he had to borrow money to cover the initial costs of planting chili…. Also during this time the price of chili was very cheap and we began to worry. The option to migrate was decided immediately because he had the debts [from chili farming]….

Another informant expanded on the frustrations of farming:

> If there is a harvest, then there is no chili price [the price is low], and the coyotes come to buy the chili as if it hurts them, although they sell it very well…but here since the people have no one else to sell to, the only option is to sell at this price even though they might get back only half what they invested. And when there is a price [the

	Non-migrant Households	Migrant Households	Households with a Migrant Head-of-Household (a subset of migrant households)
Number of households in the sample	10	16	11
Mean age of male household head	39.5 (19.4)	43.0 (13.0)	37.2 (10.7)
Mean years education of male household head	4.3 (3.9)	2.9 (2.3)	3.6 (2.0)
Mean number of household members	4.1 (1.1)	4.5 (1.1)	4.7 (0.8)
Mean number of rooms in house*	2.0 (1.2)	2.9 (1.3)	2.7 (1.1)
Mean rooms per person in house*	0.5 (0.3)	0.7 (0.3)	0.6 (0.2)
Mean housing materials index*	6.4 (1.8)	7.3 (1.1)	6.9 (1.2)
Mean number of domestic appliances*	2.1 (2.3)	3.3 (1.8)	3.4 (1.3)
Percent with a vehicle in household*	10 % (1)	25 % (4)	18 % (2)
Percent with a member holding ejidal land rights*	20 % (2)	81 % (13)	73 % (8)

*wealth indicators

Table 1: Basic characteristics of the case study households, year 2002, with household migration status determined by whether or not at least one trip was initiated between 2002 and 2004 (standard deviations in parentheses follow means, number of households in parentheses follow percentages).

> price is high], the weather is bad and there is too much rain or not enough rain or a hurricane comes. But each year something has to happen to the chilies. And for this reason, people have to migrate.

Prospects outside of farming one's own land are likewise viewed as dim. One migrant's wife told us, "He went to the north because he was earning very little as a laborer, and he wanted to build a house, have more money, and live well in the ejido." Another woman spoke of her daughter's decision to migrate along with her husband: "My daughter also went to the north, because she had no work, and she did not find work anyplace, not even in Xpujil. For this reason she left, because she has a little girl to maintain."

Second, migration has become an *economically feasible* livelihood strategy as chili cultivation earnings have allowed the accumulation of relative wealth by a subsection of the population. These wealthier households—"winners" in initial chili activities—were the early adopters of migration as a household strategy and subsequently financed the migration of others through the patron-client system. Comparing various wealth indicators for 2002, the interviewed migrant households are on average wealthier than the interviewed non-migrant households (Table 1; this is discussed in greater detail below). A woman explained how her husband was able to afford the trip: "He sold his truck. He bought that truck years ago with money from planting chili." Another told us, "One part of the money for my husband's trip came from growing chili and working in the fields as a laborer, and the rest was borrowed." Yet another woman recounted that growing chili had made the trip financially possible for her husband by providing the cash for her and the children's expenses in his absence: "The money that maintained the family was from our chili cultivation, at least for survival until he sent the first remittance." Chili cultivation over the last several decades contributed to a *relative* growth in cash income and household wealth within Nueva Esperanza and has enabled the initiation of migration to the U.S., as an unauthorized border crossing cost roughly U.S.$2,000-3,000 in 2004 (around 20,000 – 29,000 Mexican pesos).

Durand and Massey (1992) argue that wealthier households are often the first in a given community to engage in migration, but that as the community gains migration experience and establishes networks, and migration itself thereby becomes less risky, the poorer households join the migration flows. As of 2004, migration was just beginning to spread to the poorer households in Nueva Esperanza as costs and risks dropped, as a result of the establishment of migration networks and the growing availability of local credit to finance the migration trips of those without their own means—credit availability resulting in large part from the migration earnings of earlier migrants. The wife of a recent migrant informed us that her husband borrowed the money for the trip from his patron: "He borrowed money, some 20,000 pesos from 'el señor de siempre'[12] who has money, well he plants a lot of chili…. and his sons are in the north and their money is the loan capital."

These conditions often lead to a migration decision by individuals both with and without local land rights. In 2002, twenty percent of the non-migrant households held an ejidal right, while 81% of the migrant households held one (Table 1). This difference suggests relative household wealth, specifically through ejidal rights, is a migration-enabling condition, but it also suggests that ejidal lands on their own are not sufficient to enable livelihoods. As agricultural credit is scarce, cash must be found through other means, in order to make ejidal land productive (Durand et al. 1996). One interviewee told us, "The principal motivation to migrate was that my husband no longer had the option to farm [he had indebted himself prior seasons and could not afford the inputs] and so it

would be better to work in the U.S. in order to capitalize himself." In the case of another woman's husband, "Before he couldn't dedicate himself just to chili, he wanted cattle, but as it was difficult to get support from the municipality or credit, he went to the U.S. to generate the capital, to self-develop his own [agricultural] investment."

To analyze who within the ejido migrates to the U.S., and the potential connection of this to relative wealth from chili cultivation, we examined the following household wealth indicators: number of rooms in the house, rooms per person, housing materials index, number of domestic appliances, possession of a vehicle, and household ejidal rights status (does at least one member of the household have ejidal rights) (Table 1). Several of these indicators merit comment. For the housing materials index, this study collected data on floor material, roof material, and wall material and then combined the construction data into an index ranging in value from three to nine, where three represents a home constructed of the cheapest materials and nine represents one constructed of the most expensive and desirable materials. The index accounts for the fact that households might vary the order in which they upgrade their homes (walls, floors, ceilings), as income becomes available. For the number of domestic appliances, the following appliances were included: stove, refrigerator, radio or stereo, television, blender, clothes washing machine, and sewing machine.[13] The last wealth indicator, household ejidal rights status, is particularly important in the region, as ejidal rights provide access to land for chili cultivation, as well as increased access to numerous forms of income, particularly state income transfers through programs such as PROCAMPO, *Alianza para el Campo*, and *Programa de Empleo Temporal*.[14]

Comparing the means and percentage rates based on household migration status for these household wealth indicators, we see that sampled migrant households had in 2002, on average, more domestic appliances and bigger houses (as shown by number of rooms in house), used more expensive materials in the construction of their homes, and were more likely to own a car, truck, or tractor than non-migrant households (Table 1). At this early point in the initiation of ejidal migration (2002), most of the migrant households had yet to realize any earnings from migration; some had yet to even initiate their first trip. This evidence together with the difference in rates of household ejidal rights status suggests that household wealth made a difference in Nueva Esperanza in whether or not a household member migrated, at least at this early stage in the community's migration experience. It is critical to note here that these wealth differences are largely the result of the successful chili cultivation by a group of households early in the establishment of chili production in the region.

With time, migration chains are established between the sending community and individuals and locations in the U.S. (CONAPO 2001, Davis and Winter 2001, Durand and Massey 1992), and these networks facilitate or enable expanding migration rates. In addition, the community itself accumulates a base of migration experience and resources. This includes resources to finance additional trips, as well as the connections to people, which serve to facilitate migration and reduce risk. Migration earnings may be used not only to pay for subsequent trips of the same individual; they may also be used to finance the trips of other individuals. One of our interviewees, for example, lends out (at 15% interest) cash received from remittances sent by a son in the U.S. This cash is borrowed by other members of the community to pay for their own trips. Those interviewed who had borrowed to finance migration trips frequently had experienced recent "disasters" with chili cultivation, due to low prices, high input costs, and the devastation of hurricanes, such as Isidore in late 2002.

Land-use change through migration earnings investment

What impact, if any, is migration having on land use and, by extension, on tropical forests? These impacts occur through two linked processes: through the investment of migration earnings in agriculture, and through changing household land-use decision making and labor distribution. A number of scholars have argued that remittance flows to the rural areas of Mexico make it possible for those who remain behind to stay on the land (Gurri and Moran 2002, Kearney 1996, Massey et al. 1998). There is certainly evidence in Nueva Esperanza that some remittance inflow to the local household economies occurs: Ten of the sixteen households with a migrant in the U.S. received remittances at some point. Some cash is spent on immediate household needs, like food and clothes, some is spent on durable goods, like TVs and CD recorders, and part of the money is saved on behalf of the individuals sending them (for their use on return). Some migrants plan to start small businesses upon return ("My husband is saving to open a small store"), while others are using remittances to capitalize micro-enterprises immediately ("I buy jewelry and other goods with money my husband sends and then go out with my daughters to sell them, and in this way we increase the money"). Still others are saving to capitalize agricultural ventures. A returned migrant recounted, "Well, to find a way to cultivate the land… before I had no means to invest; now I have money, so now I can." Informants also reported that, for a growing number of households, a portion of remittances is used to repay debts used to finance the migrant's trip to the U.S. As another informant told us, "When my husband sends me money, I personally go and take a payment to my husband's patron. Sometimes I take him 600 pesos, sometimes 1,000."

As migration is a newly emerging phenomenon in Nueva Esperanza, most of any potential investments are planned for the future and it remains to be seen if they will take place. Remittances, however, even when applied to consumption and household maintenance can free up household resources for other purposes. For this reason, it is important to assess changes or differences in household spending and investment, not just how migration earnings, such as remittances, are spent directly.

As discussed earlier in this paper, researchers in other regions have found that migration earnings are not invested in agricultural production and are more likely to be invested in homes and spent on consumables and the maintenance of households. Our findings in Nueva Esperanza inject some question into this generalization. Much as Cohen (2004) has found that a certain amount of migration earnings go towards productive investments, we found that households with migrating members are spending on long-term agricultural investments like timber trees and pasture for cattle. Significantly, more migrant households increased their investment in agricultural land 'improvement' between 2002 and 2004 (Fisher's exact $p=0.07$), than did non-migrant households (Table 2). Land improvements considered were of three different types, all of which require cash—land mechanization, pasture establishment, and tree planting (both fruit and commercial-grade hardwood).

Land mechanization in the region is the preparation of fields through the use of heavy tractors, and represents an alternative strategy to traditional swidden land clearing and preparation techniques associated with the *milpa*.[15] "Mechanized" fields are placed into permanent cultivation and are a key component in local land intensification strategies. In 2002, fifteen of our sampled households had some mechanized land, ranging from 1 to as many as 20 hectares. Pasture establishment involves the conversion of primary, or more commonly, previously cultivated secondary growth into grass cover. Once established, labor requirements for maintenance are relatively low, and the land can be used to graze any cattle owned by the household or rented out for the grazing of cattle owned by other households. In 2002, three households in our sample of twenty-six main-

tained or planted pasture land, and just one year later, nine households did. As of 2004, not one household in the community owned cattle, yet households in neighboring ejidos did, and there has developed in Nueva Esperanza a widespread aspiration towards the production of cattle. Planting tree seedlings on ejidal parcels is relatively common as the result of widespread encouragement of the practice through state and private conservation programs. During the 1990s, tree seedlings were often given free of cost to households via conservation projects. Many of the trees from early projects are now generating a financial return to select households, particularly the fruit trees. In the case of the hardwoods (primarily cedar and mahogany), tree maturity is eagerly awaited by households, as a mature mahogany, for example, can bring up to 5000 Mexican pesos (US$500). Many households desire more tree seedlings, but many conservation projects have shifted to a credit model, requiring households to pay back the cost of the seedlings.

When considered separately, only in the planting of hardwoods did we find a statistically significant difference between migrant and non-migrant households ($p=0.10$). However, when considered as a group (mechanization, pasture establishment, or fruit and hardwood tree planting), as various options for productive investment in land, migrant and non-migrant households exhibited significant differences: 67% of migrant households increased their hectare holdings of "improved" lands between 2002 and 2004; whereas only 25% of non-migrant households did ($p=0.07$).

There is less evidence of other investment directly in production, in the form of higher purchases of livestock, tractors and trucks, or agricultural inputs such as fertilizer or pesticides. Some individuals, however, are investing in land, purchasing *solares* (residential land) and/or *parcelas* (agricultural parcels), which may be an indicator of future productive intentions. For example, of the four interviewed households gaining an additional ejidal land right from 2002 to 2004, three were households with a son sending remittances from the U.S. Unsurprisingly, there also is evidence that a portion of earnings are going towards home improvement and consumption, as has been found elsewhere in Latin America. Between 2002 and 2004, more migrant households (53%) bought additional domestic appliances than did non-migrant households (20%) (Table 2, Fisher's exact $p=0.11$). This increase in consumption does not preclude migrant households from increasing certain types of productive investment, even at these early stages of migration.

The qualitative interviews bolster these statistical findings on the investment of migration earnings in agriculture. One returned migrant informed us that he was mechanizing his land as a direct result of having additional money available: "Now I am mechanizing even maize." A woman and her migrant husband are saving to build a nice house and to buy a van to use for a public transport business, but they are also planting pasture grass with the notion of getting cattle. Another couple is saving the husband's migration earnings to buy the land parcels surrounding his parcel: "The savings we are accumulating now are so that when my husband returns he will put in good pasture and we will buy the land bordering his parcel so as to have a bigger area for cattle raising." Another couple also plans to invest in land improvement for agriculture: "We want to put in grass and sheep with the little money we will have, and to mechanize more land for planting maize, but not chili. Also we want to reforest so that they will pay us to care for the cedar trees, as he [the husband] is in a reforestation project. Also we would like to save some money to get some cows and produce milk."

Not all of the migrant households, however, see a future in agriculture. Some, particularly those most disappointed by their previous failures in agricultural production, are turning to other types of investment, including in land as a real estate asset. One woman reported that she and her husband are no longer interested in pursuing

agriculture: "We are not going to invest in sheep because the tiger [jaguar] eats them… it is better to invest in something profitable…we already have bought land in Xpujil to build rooms to rent out."

There is evidence that certain types of agricultural investment (capital inputs for land improvement) are already associated with transnational migration. Many of these investments occur to facilitate cultivation that meshes more readily with repeated migration trips, or requires less regular maintenance or intensive labor, such as pasture and tree cultivation. Future research is needed to follow these early findings to see if these investments continue, and to determine what conditions the choice of a land improvement type—pasture for cattle, versus mechanization for intensified commercial chili or maize cultivation, versus managed forestry and fruit tree cultivation. The different types of agricultural investment have significant differences in potential impact for current trends of forest recovery in Nueva Esperanza, and in the wider SY region.

Early impact of household-head absence on chili and maize cultivation

The two most important crops cultivated in Nueva Esperanza and the SY region are maize and chili peppers. Maize is cultivated primarily as a subsistence crop, but any surplus is sold in local markets. Chili is cultivated as a cash crop, sold green as jalapeño peppers or smoked ripe to produce chipotle. The cultivation of these two crops has had a significant impact on forest clearing since the region's settlement as an agricultural frontier. As, by necessity, livelihood strategies in the region become more mixed in nature and begin to encompass transnational migration, changes in cultivation extent might be expected, with important implications for local landscapes and forest recovery efforts.

In addition to the potential effects on land use through investment in agriculture and land, increasing household involvement in transnational migration can be hypothesized as resulting in one or more of the following direct cultivation outcomes:

- Individuals who migrate and leave behind established households pay other people to work on their plots, resulting in no change in cultivation.
- Women increase their labor in cultivation to substitute for absent husbands and/or sons, resulting in no change or in smaller cultivated plots.
- Households abstain from or reduce cultivation during the absence of the husband.

Table 3 summarizes this study's findings in Nueva Esperanza on immediate land-use outcomes resulting from the transnational migration of male heads-of-households and changes in cultivation decision making. At this early stage in migration, maize cultivation is relatively unaffected by the absence of husbands, with households continuing to cultivate small plots ranging from 0.25 to 4.0 ha. A combination of the first two possible outcomes appears to be occurring for subsistence cultivation (primarily maize), as women supervise paid labor (*jornaleros*) or engage in increased field labor themselves (see also Radel and Schmook 2005). This result is similar to what has been found in Ecuador (Jokisch 2002) and elsewhere in Mexico, but only for certain segments of the population (Mines and de Janvry 1982). In the SY, a critical factor in this decision appears to be PROCAMPO payments which are available only to registered households who cultivate basic staples year after year. Failure to cultivate might lead to a loss of payments. Women rarely take over field labor completely, but many do increase their labor input in maize cultivation substantially and assume new supervisory roles (Radel and Schmook 2005). In 2004, migration from the community did not appear to have created labor shortages affecting the cultivation of basic staples, but this may well change as migration expands.

Another critical factor in the continued cultivation of maize in Nueva Esperanza is a desire to meet subsistence needs while saving scarce cash. One of our interviewees

	Migrant Households	Non-migrant Households	
Number of households in sample	16	10	
	Percent	*Percent*	*Cross-tabulation Fisher's Exact Sig. (1-tailed)*
Consumption and Home Investments:			
Increase in rooms in house	19	40	0.23
Increase in housing materials index	27	10	0.31
Increase in domestic appliances	53	20	0.11
Agricultural Investments:			
Increase in vehicles (incl. tractors)	13	10	0.68
Increase in hectares in pasture	33	11	0.24
Increase in hectares mechanized	21	0	0.24
Increase in hectares planted in fruit trees	13	13	0.73
Increase in hectares planted in timber	31	0	0.10
Increase in any of three (hectares under pasture, mechanized, or tree-planted)	67	25	0.07
Increase in household-held ejidal land rights	19	10	0.50

Table 2: Comparison of home and agricultural investments for migrant versus non-migrant households, based on migration between 2002 and 2004.

explained this: "Well now that my husband is not here, I had maize planted [she hired someone], first mechanizing [disk plowing] the land… but this was my decision, not his. I did this because it is more expensive for me to buy maize, and since I have the land …." Another woman expressed this same basic subsistence idea: "I hired someone to plant maize for me, completely paid and with the help of my father-in-law, because maize is what we need the most, at the very least for the tortillas and *atoles* [corn flour drink], because this way I save a lot of money." These two women exemplify the continued cultivation of maize through the hiring of paid male labor as a cheaper substitute to the purchase of maize or tortillas in the local stores. Other women, however, increased their own labor in the fields during their husbands' absence: "Right now my husband is in the U.S. and I go together with my sons to the parcel to plant and weed. We hire laborers for the planting, and then the family only does the weeding. I supervise the laborers'

work with my 12-year-old son. When my husband returns, he will dedicate himself to the parcel and I will no longer go, only my sons." The findings of other researchers in regions and localities with a longer history of circular migration and remittance receipts (*e.g.* Hecht et al. 2006) suggests that this subsistence cultivation of maize may well change as transnational migration as part of a mixed livelihood strategy stabilizes further and migration earnings become more reliable for households.

A reduction of cultivation during the absence of the male head-of-household appears to be the case for chili cultivation among many of the interviewed households (Table 3). For example, during 2002, 81 percent of households with a male head-of-household present planted chili; while only 44 percent of those without a male head-of-household present did so (Fisher's exact p=0.09). Some households do continue to cultivate chili even in the absence of the husbands; for many, however, migration substitutes for chili cultivation: "Now that my husband has gone, the parcel is not worked. Not until he returns." Or, as another woman put it, "We aren't cultivating chili because el señor is in the U.S. And the other years when he wasn't here, we didn't farm either. When my husband returns he will plant a little chili, like a half hectare, only to amuse himself."

For migrants without their own established households (*i.e.* sons) migration often substitutes for chili cultivation which otherwise would occur on the family parcel but for the benefit of the individual alone (not for the shared benefit of the household). Chili production is viewed locally as a male activity, with cash earnings received by men. It also requires substantial cash investment in chemical inputs, the hiring of wage labor for harvesting, and negotiations with middlemen. As noted, chili cultivation carries potentially high rewards but also carries high risks (Keys, 2004b). Maize production, on the other hand, is less labor- and capital-intensive, and the harvest provides for the consumption needs of women and children (as well as of fowl) remaining in Nueva Esperanza during the absence of the husband.

Significantly, increasing ease and decreasing cost of international communication has changed the nature of men's absences during transnational migration events. One woman in the sample, for example, engaged in regular telephone conversation with her husband during his 2002 trip to the U.S., during which they discussed the state of the household's crops and the woman received instruction on the management of the household's continued cultivation: "He calls me every week or so and tells me what I should do." Mahler (2001) has found similar types of communication between spouses in rural El Salvador. This allows the absent husband to maintain his role as primary agricultural decision-maker. For many Nueva Esperanza households, however, the gendered division of agricultural labor is impacted, as women engage in more field labor, especially in the supervision of *jornaleros*. The effects of the emerging pattern of migration on the gendered division of agricultural labor and on the gendered control of agricultural decision-making in the region are discussed elsewhere (Radel and Schmook 2005).

Future data collection will be necessary to assess potential changes in cultivation patterns both with the return of migrants and with the increased regularity of remittances. Most 2002 migrants were also absent in 2003 (some having returned in the interim and left again, and some not yet having returned), and 2004 cultivation data was not yet available at the time of the 2004 interviews. It is also possible that as the community's experience with migration continues and as U.S.-Mexico border controls tighten, restricting movement back and forth, entire households may relocate to the U.S. on a more permanent basis (Massey et al. 2003). The potential effect of this on land use will depend, in part, upon whether these households are allowed to and choose to maintain ejidal land rights, or whether the rights and the land are transferred or sold to other individuals. Currently, migrating ejidatarios request that the ejidal as-

	2002		2003	
	Husband Absent [a]	Husband Present	Husband Absent [a]	Husband Present
Households in sample	9	16	11	15
Planted chili	44 % *	81 % *	46 %	67 %
Planted maize	67 %	69 %	73 %	67 %

a. including households without a husband for various reasons other than migration, including his death
* Cross-tabulation Fisher's exact statistic significant at 0.1 level (2-tailed).

Table 3: Effects of migration on the cultivation of maize and chili.

sembly grant them permission for a temporary absence from Nueva Esperanza, and permission is readily forthcoming. If entire households relocate, this situation may change. Effects of migration on common resources will be mediated by the way migration impacts the institutions (i.e. the ejidal assembly) that regulate those resources, through the make-up of ejidal leadership and the interpretation of rules governing longer-term absences and failures to cultivate. The future of natural resources, such as commonly held forest land, and the landscape in the ejido therefore depend on how institutions adapt to the new situations created by migration (VanWey et al. 2005).

Conclusions

Migration to the U.S. from the study region, at a larger scale, is as recent as the turn of the millennium; therefore, it is impossible to assess its longer term impact on livelihoods, land use, and forest cover at this point. Nevertheless we can draw some conclusions on the early effects, and establish the existence of a link between transnational migration as household livelihood strategy and land-use changes in one case study ejido. U.S. migration from the SY increased around the year 2000 due to the decreasing availability of off-farm income-generating possibilities and the inability of many farm households to generate a suitable income from farming practices alone. Given poor returns generated by the labor-capital-output relationships of the current system employed, and risk created by thin markets and vagaries of nature, ejidal farmers increasingly viewed migration as a desirable supplement to semi-subsistence agricultural production in the context of globalizing free markets and the low priority of the agricultural sector for the Mexican government. Yet, ironically, it was the momentary financial successes of agricultural chili production in the 1980s and 1990s for particular households that capitalized transnational migration as a possible response of local agents (individuals and households) to today's structural factors. Similar to McKay's (2005) findings in the Philippines, transition to cash cropping provides the financial resources necessary for transnational migration. In this sense, the initiation of migration in Nueva Esperanza reflects the partial insertion of households into global labor and commodities markets (Schmook and Radel 2008 forthcoming).

Although in some places migration has been associated with agricultural abandonment (López et al. 2006) and forest recovery (Hecht et al. 2006), currently in the case study ejido migration of the male head-of-household does not mean that families completely abandon agriculture in his absence, and the data presented here suggest that maize cultivation—largely undertaken for direct consumption—is unaffected by his absence, at least early in a household's experience with migration. There is evidence, on the other hand, that chili cultivation, as a cash crop, decreases with the absence of husbands, with households substituting migration for chili cultivation in given seasons and perhaps overall. In general, however, migration is being *added* to an increasingly diversified mix of livelihood strategies adopted by different household members, and is not yet substituting for local, in-place strategies, including cultivation.

Much as Sana and Massey (2005) recently found elsewhere in Mexico, where migration earnings are used for local productive investments in order to diversify household risk, we found in Nueva Esperanza that the addition of migration to a household's increasingly diversified mix of livelihood strategies is also associated with increasing investments in certain in-place strategies: Migrant households in Nueva Esperanza are investing in their land at higher rates than are non-migrant households—planting trees, expanding land under pasture, and mechanizing land preparation. Thus, we find that migration is leading to less investment in chili, but more investment in other kinds of agriculture. Future research will need to follow these initial trends to see if they continue

and if local desires to purchase cattle, for example, become a reality. It is possible, however, to speculate about overall future land-use transformation and the fate of forests in the region and how this will be affected by a continuation and expansion of the emerging migration patterns. Migration to the U.S. (and to elsewhere in Mexico) is likely to increase in the immediate future. It appears that Mexico's neoliberal policies in the agricultural sector are 'successfully' shifting many out of commercial agriculture, in this case chili, leading these farmers and their families to search for alternate and supplementary means to achieve viable livelihoods at the same time that they maintain small subsistence plots and invest in their land for the future. Relative community wealth, generated via high-risk participation in chili markets, and the establishment of transnational migration networks have enabled the male Nueva Esperanza farmer to become a 'global' subject through the addition of transnational migration to a mixture of household livelihood strategies that reflect both the constraints and the opportunities of economic and social globalization. At root, these transformations have only been possible as the result of an earlier landscape transformation of forest to a forest mosaic that included commercial chili cultivation, and not just semi-subsistence maize cultivation.

Our case study establishes the relevance and importance of this type of empirical research to understand the nature of productive in-place investments that may take place in rural migration-sending communities of the developing world, as both labor and markets continue to globalize. In this respect, we are arguing that it is possible that not in all places will migration lead to the emptying of the countryside or the abandonment of agriculture. This is in contrast to recent generalized claims that, especially in Latin America, agricultural lands are being abandoned and ecosystems are recovering as a result of rising migration rates (Aide and Grau 2004). Better understanding of migration and land-use linkages is necessary if we are to predict and attempt to influence the inevitable transformations in ways that can lead to healthier communities *and* environments.

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Notes

[1] The SY is a term coined by the Southern Yucatán Peninsular Region Land-Cover Land-Use Change Project (SYPR); see Figure 1. SYPR is a collaboration of El Colegio de la Frontera Sur (ECOSUR), Harvard University, Clark University, and CIS-CMU (see http://earth.clarku.edu/lcluc/). This large, multi-disciplinary project incorporates various elements, including economic and agent-based modeling, remote sensing and land-cover classification, ecological studies, and historical, political, and institutional analyses. The SYPR team has been conducting multidisciplinary research in the region since 1997, documenting and modeling land change in the region and the consequences of changes for the well-being of the coupled human-environment system (Turner et al. 2004).

[2] The ejidal sector is made up of the rural agricultural ejidos, which are units of land as-

signed to groups of peasant farmers under Mexico's agricultural reform system. Usufruct rights for these land units are collectively held by the ejidatarios.

[3] Nueva Esperanza is a fictional name. We have chosen to maintain the anonymity of the ejido given the sensitive nature of migration to the U.S., especially when unauthorized. For this reason Nueva Esperanza is not located on Figure 1.

[4] The second author has been living and working in the region over the last 12 years as a researcher with Mexico's El Colegio de la Frontera Sur, resulting in an accumulation of knowledge and understanding.

[5] Two of the households in the sample are headed by a woman with no husband and one or more of her adult sons. In the study, we treat these sons as analytically equivalent to husbands.

[6] Personal communication, June 2004, staff member of Pronatura Peninsula Yucatán (PPY). PPY is the largest non-governmental environmental organization working within the SY, with national and international funding.

[7] The SY region straddles the southern reaches of two states, Campeche and Quintana Roo, and wholly encompasses the municipality of Calakmul, Campeche.

[8] OPORTUNIDADES is an anti-poverty program, with cash disbursements to households conditioned on participation in health and education activities. PROCAMPO (Program of Direct Payments to the Countryside) is the state program of financial direct transfers to farmers in support of agriculture; see Klepeis and Vance (2003).

[9] See Klepeis and Roy Chowdhury (2004) for a discussion of the role of state transfers in the SY ejidos.

[10] Busch (2006) documents that in 2003 in the SY region, the mean return (after hired labor and agrochemical input costs) for a hectare of planted chili was 5,100 Mexican pesos (min -9,600, max 70,750). These figures illustrate that even as recently as 2003, a good return for a chili farmer leads to significant cash accumulation. However, a bad return may lead to financial ruin.

[11] Land cover classification maps were generated by SYPR, which included the second author. See note 1.

[12] 'El señor de siempre' is a local patrón and the wealthiest man in the ejido, who initiated the local cultivation of chili.

[13] It is worth noting that these appliances are not equal in cost and that this introduces some error into this indicator.

[14] PROCAMPO (Program of Direct Payments to the Countryside) and Alianza para el Campo (Alliance for the Countryside) are both financed by Mexico's Secretary of Agriculture, Ranching, Rural Development, Fisheries, and Food Supply (SAGARPA). SAGARPA and the Secretary of Social Development (SEDESOL) both offer Programa de Empleo Temporal or PET (Temporary Employment Program).

[15] The milpa in Mexico is a traditional field, planted with maize and other accompanying crops, under a swidden system.

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