Rural Out-Migration to Alternative Destinations in the Southern Ecuadorian Andes: The Roles of Environmental Assets and Livelihood Diversification

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Abstract

Out-migration from rural areas is a key driver of socio-environmental change in the developing world, but connections between this process and rural livelihoods have not been fully explored. Motivated by the literatures on environmental refugees and livelihood diversification, this paper addresses the influence of environmental assets and livelihood strategies on rural out-migration from the southern Ecuadorian Andes. The data originate from a multilevel longitudinal survey implemented in a key region of out-migration and environmental risk. I use a multinomial event history model to compare the effects of demographic and contextual factors and livelihood activities and assets on out-migration to local, rural, urban and international destinations. The results indicate that (1) drivers of out-migration differ substantially across migration streams, (2) origin-area livelihood diversification primarily increases internal migration but mostly decreases international migration, and (3) environmental assets have important influences on out-migration, but effects are not unidirectional as predicted by the literature on environmental refugees.

Introduction

The departure of people from rural areas (i.e., rural out-migration) represents one of the primary forms of human population redistribution over the past century with profound impacts on urban, frontier, and international destinations as well as on rural origin areas (Friedberg and Hunt, 1995; Taylor et al 1996; Bilsborrow, 1998; De Jong et al, 2006). In attempting to understand the causes of these and other migration flows, migration studies have conclusively demonstrated the importance of individual characteristics, migrant social networks, and economic conditions such as unemployment and wage rates in determining who migrates and from where (White and Lindstrom, 2005). Complementing these empirical results, a key theoretical advance has been to consider the influence of household and community contexts on the out-migration decisions of individuals (Wood, 1982; Bilsborrow, 1987), decisions which may be part of an overall household livelihood strategy (Stark and Bloom, 1985). In the rural developing world, agricultural activities are a key component of many household livelihood strategies, but few studies have examined the impacts on migration of widespread processes of agrarian transformation such as land fragmentation and consolidation, environmental change, and diversification or de-agrarianization of rural livelihoods (Rigg, 2006). Drawing on the livelihoods framework (Ellis, 2000), these processes of agrarian transformation can be conceptualized as changes in household livelihood activities (e.g., wage labor) and in access to environmental assets (e.g. fertile soil). These issues are particularly resonant in the South American Andes where out-migration has commonly occurred from rural areas with high

population density and vulnerability to environmental change (Zimmerer, 1993; Preston et al 1997).

To better understand connections between out-migration, rural livelihoods, and the environment, I conducted a household and community survey in Loja province in the southern Ecuadorian highlands, an environmentally vulnerable region of rapid out-migration to rural, urban and international destinations. The survey collected structured 12-year histories for all individuals, agricultural plots and communities connected to 397 households in five rural cantons[1]. I draw on these data to ask: what are the origin-area drivers of rural out-migration in the study area, and specifically what are the roles of environmental assets and livelihood activities? To address these questions I estimate a cluster-corrected multinomial discrete-time event history model of out-migration to local, rural, urban and international destinations as influenced by individual, household and community characteristics over time including livelihood activities and environmental characteristics of household lands. The results indicate that (1) drivers of out-migration differ substantially across migration streams, (2) origin-area livelihood diversification primarily increases internal migration but mostly decreases international migration, and (3) environmental assets have important influences on out-migration but effects are not unidirectional as predicted by the literature on environmental refugees.

Out-Migration and Rural Livelihoods

Human migration can be viewed as a multiscale process in which the migration decisions of individuals are influenced by personal characteristics and experiences, by the household context, by opportunities within the community and in potential destinations areas, and also by broader macro-structural factors[2] (Massey et al, 1993; Massey and Espinosa, 1997; White and Lindstrom, 2005). At the individual level, measures of age, education, sex, and migration history have been linked to out-migration, capturing effects of lifecycles, gender norms, and selectivity for human capital (White and Lindstrom, 2005). Migration decisions are often made jointly with other household members and thus reflect power relationships within the household, household demographic composition, and current and alternative household livelihood strategies such as agricultural activities and off-farm employment (Wood, 1982; Stark and Bloom, 1985). Livelihood strategies have most often been measured simply as the occupational category of the household head (e.g., Lundquist and Massey, 2005), but measures of multiple and diverse livelihood activities would likely better capture household economic status and the scope of alternatives to migration (see Ellis, 2000; Reardon et al, 2001). Migration decisions also reflect household resources including human, social and physical capitals or assets (Scoones, 1998; Ellis, 2000) which can be measured as educational attainment (Levy and Wadycki, 1974), social connections to previous migrants (Massey and Espinosa, 1997), and wealth in the form of land, a home, or a business (VanWey, 2005). The effects of these factors are likely to be nonlinear and to differ across migration streams (Davis et al, 2002; VanWey, 2005). For households relying on agriculture or wild product harvesting, migration decisions are also likely reflect access to natural capital or environmental assets such as irrigation (Katz, 2000; Davis et al, 2002), high quality soil (Laurian et al, 1998; Barbieri, 2005), and forested land (Henry et al, 2004; Shrestha and Bhandari, 2005; Rindfuss et al, 2007), though these effects have been investigated by few studies beyond those cited.

[1] Cantons are Ecuadorian political units roughly equivalent to US counties.

[2] Due to data limitations this study does not examine the effects of macro-structural or destination characteristics on out-migration.

Beyond the household, contextual factors such as community infrastructure and the availability of land and employment limit the opportunities of non-migrants and have been shown to influence migration (Lindstrom and Lauster, 2001; Beauchemin and Schoumaker, 2005; VanWey, 2005). The role of the environmental context, including the effects of flooding, deforestation and soil degradation, has been emphasized by a number of studies of "environmental refugees" (Myers 1997; Hugo, 1996). These studies have focused on the potential for environmental changes to serve as pushes for out-migration, but a small number of population-based studies have found mixed effects (Findley, 1994; Munshi, 2003; Henry et al, 2004; Gutmann et al, 2005).

Several studies in Ecuador have previously investigated contextual and livelihood effects on migration, including studies of out-migration from the rural highlands by Bilsborrow (1987), Brown et al (1988), and Laurian and Bilsborrow (2000) as well as a study by Barbieri (2005) of out-migration from the Amazonian lowlands. Bilsborrow (1987) found male out-migration to decrease with opportunities for agricultural wage labor and to peak at intermediate values of land available to the household. Brown et al (1988) created indices of canton-level variables and showed that scores for long-standing settlement and modern socio-economic structure increased migration and that scores for subsistence-oriented agriculture and large-sized farms decreased migration. Laurian and Bilsborrow (2000) found out-migration to increase with non-agricultural employment and the number of services in the community, and to decrease with population size. Barbieri (2005) showed that soil quality and land area in pasture increased migration, that land area in crops and non-agricultural employment decreased migration, and that total farm area had mixed effects. These studies confirm that the agrarian and livelihood context have important influences on rural out-migration in Ecuador, but many potential additional factors remain unexplored. Additionally, no previous study has examined the determinants of international out-migration from Ecuador.

These studies demonstrate the complexity of influences on migration, but the migration event itself can be equally complex: mobility takes place over multiple temporal and spatial scales, migrants may move again or return to their place of origin, and origin-area influences on migration to one type of destination (e.g., rural) may differ significantly than those for another type of destination (e.g., urban) (White and Lindstrom, 2005). Despite the recognition of this complexity, few studies in the developing world have compared migrations across scales or type of destination (for exceptions see Davis et al, 2002; Henry et al, 2004; Barbieri, 2005; VanWey, 2005). This study advances the existing literature by comparing the drivers of rural out-migration across four destination types and from local to international scales.

Study Area and Data Collection

Over the past fifty years, Ecuador has experienced large-scale rural-urban as well as rural-rural migrations which have contributed to rapid urbanization and advances of the agricultural frontier (Brown et al, 1988; Brown and Sierra, 1994). During a period of economic crisis and political instability since 1990, over one million Ecuadorians[3] have also emigrated to the United States, Spain, and other countries, many of them from rural areas (Jokisch and Pribilsky, 2002; Ramírez and Ramírez, 2005). Although international remittances from these migrants represented 6.4% of Ecuador's Gross Domestic Product in 2005 (IADB, 2006), the public perception of international migration is largely negative and the government recently proposed using development aid to discourage international migration (The Associated Press,

[3] The current population of Ecuador is approximately 13 million.

2007). Figure 1 displays the international out-migration propensity[4] from 1996-2001 for each Ecuadorian canton and also identifies the five-canton study area[5], a high-propensity cluster in the far southern highlands. The study area is an isolated, poor, and predominantly rural region where smallholders and medium-scale cattle ranchers cope with steep slopes, a poorly-developed transportation network, and a highly seasonal climate with recurrent droughts. In addition to international migration, this region has a long history of sending migrants to the coastal and Amazonian lowlands and to the capital city of Quito in the northern highlands (Brownrigg, 1981; Brown et al, 1988; Brown and Sierra, 1994). Many observers have anecdotally linked these movements to environmental factors such as drought (e.g., OAS, 1992).

To better understand connections between migration, livelihoods and the environment in the region I conducted a household and community survey in early 2006, beginning with a two-stage sampling procedure. From the five cantons, 18 rural census sectors containing 36 communities were selected through systematic random sampling with probabilities proportional to population size, which was estimated from the 2001 census. Working in each community with a group of residents, a household listing operation was conducted to list all resident households and identify those which had sent one or more migrants to internal or international destinations since 1995. This list served as the frame to select a sample of households stratified by migrant status, allowing the oversampling of migrant-sending households. In each sampled household, trained local interviewers implemented a household questionnaire with the male or female head or another knowledgeable adult, who also served as a proxy respondent for other adult household members and departed migrants[6]. This interview collected life histories for the period 1995-2006 for each adult member of the household and all adult out-migrants since 1995, including annual information about demographic characteristics (e.g., educational attainment) and livelihood activities (e.g., wage labor). This twelve-year window was selected to limit recall error, though limited information (e.g., previous residences) was also collected for earlier dates, and certain questions were limited to the years 2006 and 1995. A similar approach was used to collect annual information about household characteristics such as demographic composition, livelihood activities, and agricultural activities on each plot of land. The questionnaires were developed in collaboration with local staff to ensure that information was collected on the most relevant livelihood activities, environmental characteristics, and contextual factors. Overall the survey collected complete information for 397 households with a 97.3% completion rate for sampled households.

To provide information on the context of out-migration decisions, in each community a community questionnaire was implemented and Global Positioning System (GPS) points were collected to be incorporated into a geographic information system (GIS). The community questionnaire was implemented with a community leader or group of community residents, and collected information on the history of services and infrastructure in the community, biophysical conditions, out-migration of entire households, and other community characteristics over time. GPS points were collected in the center of each community, and later were combined in a GIS with the following coverages: mean annual precipitation at 1 km resolution (Hijmans et al,

[4] Propensity equals the number of migrants divided by the original resident population, from my calculations based on data from INEC (2003) assuming international migrants to have departed from the household's place of residence in 2001.

[5] The study area includes the cantons of Calvas, Gonzanama, Espindola, Quilanga, and Sozoranga of Loja province.

[6] This approach does not allow detailed data collection about entire out-migrating households. Limited data was collected on these households at the community level, revealing that approximately 80% of migrants overall departed as individuals rather than as part of entire out-migrating households.

2005), a 30 m digital elevation model (Souris, 2006), and a vector layer of the road network (Universidad de Azuay, 2006). The GIS was used to extract distance from the community center to a paved road as well as mean slope and precipitation in a 1 km buffer surrounding the community center. The GIS and community questionnaires, together with data aggregated from the household surveys, allowed the construction of time-varying contextual variables for the migration analysis.

Analysis

I used these multiple data sources to construct a person-year dataset including migrants and non-migrants. The dataset contains time-varying and time-invariant variables at individual, household and community levels and each case represents one year in the life of a person at risk for out-migration, as defined below. Migration outcomes are lagged one year after predictors to reduce the possibility of endogeneity with the migration decision; thus complete data is available for years 1996-2006[7]. Male and female household heads and all individuals over 50 years old were excluded from the dataset as they had very low propensity for out-migration, leaving 304 households with adult members at risk for out-migration during the study period. Children of the head and other non-head members of the household enter the dataset within the study period when they are age 15 or older and resided in the community in the previous year. Individuals leave the dataset when they out-migrate, turn 50 years old, or are censored after 2006. Migration was defined as a departure from the origin household for six months or longer, with four destination categories defined by the first place of residence outside of the origin household for six months or longer. The four destination categories are local residential mobility (to a different household or community within the canton), rural migration (to a rural area in another canton), urban migration (to an urban area in another canton), and international migration (to another country)[8]. Corresponding to these categories, the outcome variable is coded one to four for all person-years in which out-migration occurred, and in all other person-years is coded zero. The dataset contains 65 local movers (309 person-years), 78 rural migrants (324 person-years), 331 urban[9] migrants (1393 person-years), 130 international migrants (617 person-years), and 465 non-migrants (2517 person-years), for a total of 1069 individuals and 5160 person-years[10]. Primary destinations included Quito and Loja city for urban migrants, El Oro and Zamora-Chinchipe provinces for rural migrants, and Spain and the United States for international migrants.

I analyzed these data using a multinomial discrete-time event history model. This model is appropriate for situations in which individuals are exposed to a mutually exclusive set of competing risks over time (e.g., out-migration to alternative destinations), where time is measured in discrete units (e.g., years). In this model, the log odds of experiencing a migration event of type *r* relative to the non-migration event *s* are given by

$$\log\left(\frac{\pi_{rit}}{\pi_{sit}}\right) = \alpha_{rt} + \beta_r X_{it}$$

[7] Migration propensities were much lower for 2006 due to the short interval of data collection (January-March). This is accounted for by allowing the baseline hazard (α_{rt}) to vary with each year.

[8] I refer to all four of these movements as 'mobility', and to the latter three movements out of the canton as 'migration'.

[9] Residences in canton and provincial capitals were defined to be urban, with all others defined as rural.

[10] To account for missing data, 0.2% of person-year predictor values were manually interpolated based on other information in the questionnaire.

where π_{rit} is the odds of out-migration to destination *r* for individual *i* in year *t*, α_{rt} is the baseline hazard of migration to destination *r* in year *t*, X_{it} is a vector of predictor variables for individual *i* in year *t*, and β_r is a vector of parameters for the effects of the independent variables on migration to destination *r*. The exponentiated form of these parameters (e^{β}), known as the odds ratio, can be interpreted as the effect of a one unit increase of the predictor on the probability of that type of migration relative to the probability of no migration. A derivation of the above formula can also be used to calculate the predicted probabilities of migration given the year and a set of values of the predictors. I estimate the model using Huber-White robust standard errors with clustering set at the level of the census sector, which corrects for the multilevel nature of the predictors and the clustering of person-years within individuals, households, communities and census sectors (Angeles et al, 2005). To account for unequal probabilities of selection across census sectors and households, I also include weights in the model, calculated as the inverse of the probability of selection.

To avoid misspecification of the model and to develop a comprehensive understanding of out-migration consistent with the theoretical framework developed above, I include a large number of predictors, described in Tables 1-3. These include 53 time-varying and time-invariant variables at individual, household and community levels[11], which I have categorized into six groups: demographic factors, human, social, physical and agricultural/environmental assets, and livelihood activities. In fitting the model, I tested for nonlinear effects by including squared terms for the continuous predictors, and have retained them where significant. Table 4 lists specific hypotheses for the effects of the predictors on out-migration. The effects of demographic factors and human, social and physical assets have been investigated by many previous studies and predictions draw on the studies cited above. The effects of environmental assets and livelihood activities have been investigated by fewer studies and are central to this analysis, thus I summarize the hypotheses here. As they improve opportunities for origin-area livelihoods, environmental assets and opportunities for agricultural intensification are expected to decrease out-migration, particularly internal migration as an agrarian livelihood in the origin community is a closer substitute for urban and particularly rural destinations than for international destinations. Conversely, as predicted by the literature on environmental refugees, negative environmental conditions should increase out-migration. Additionally, livelihood activities which reflect an agrarian orientation are likely to decrease out-migration to urban and international destinations, and those which reflect a market orientation are likely to increase these flows.

Results

Results from the event history analysis including odds ratios and the results of significance tests are displayed in Tables 5-7. This discussion focuses on the statistically significant effects ($p < 0.05$) and notes *p*-values for marginally significant effects ($p < 0.10$). Variable names are noted in italics.

The effects of demographic factors are shown in Table 5. As predicted, women are less likely to be rural migrants and more likely to be local movers, though the effect (*female*) is only significant for rural migration. Individuals who are not children of the household head (*other*

[11] For the sake of parsimony I removed eight non-significant predictors which did not improve the fit of the model, including participation in farm work, marital status, ownership of a business, number of household goods, management of an irrigated parcel, community elevation, vehicle access to the community, and the proportion of adults engaged in wage labor in the community.

relation) are less likely to move across all streams as expected, but with a significant effect only for urban migration. To more easily interpret the curvilinear effects of *age* and other selected predictors, the predicted probabilities of mobility (holding other predictors at their mean values) are displayed in Figure 2. Controlling for other effects, international and urban migration both peak at age 24, with the peak for local mobility slightly later at age 28. Only rural migration, contrary to predictions, does not show a significant relationship with age, suggesting that these movements may not fit the lifecycle pattern of many migrations (see Davis et al, 2002).

The effects of household composition are complex and largely contrary to expectations. International migration significantly decreases with the number of *minors* as expected but local mobility and rural migration increase. Among adults, the number of *young women* and *older women* mostly increase migration as predicted, but the number of *young men* had no significant effect and local mobility significantly decreases with the number of *older men*. These results suggest that competition between adult female children and minors for household resources may encourage out-migration, but that the farm labor available from adult men may discourage out-migration and local mobility. Additionally, urban migration is significantly higher from single-headed households (*single head*) as expected, but unexpectedly declines swiftly with *age of the head* and then rises again for the oldest heads. The latter pattern may reflect the decreased ability of the youngest and oldest heads to support the household. The effects of age of head on international migration are also jointly significant but show the predicted peak at intermediate ages of the head. Finally, and also in contrast to expectations, international migration and local mobility (p =.099) increase with *community population*, perhaps because larger social networks in these communities may enable these forms of mobility. Overall, demographic effects appear to be most important for urban migration and least important for rural migration, suggesting that urban migration is most connected to lifecycles and labor availability in the household.

The effects of human, social and physical assets on out-migration are displayed in Table 6. Among human capital variables, *school* attendance and individual educational attainment (*primary* and *secondary education*) have the predicted negative and positive effects on migration respectively, but the results are only significant for international migration, suggesting that this type of mobility is most selective for human capital. The effects of education of the head are jointly significant for urban and rural migration, increasing the former and decreasing the latter (*head primary* and *secondary education*); educated heads likely prefer and enable urban over rural migration for their household members. Among social asset variables, residence in the community for less than ten years (*short residence*) significantly increases international migration while *previous migration* out of the canton significantly reduces it. Together this suggests that international migration rarely follows previous migration out of the canton but frequently follows local mobility within the canton, most likely a return from schooling in the canton capital. Short residence time also has a significant negative effect on urban migration, consistent with the existence of a strong link between origin household dynamics and urban migration. Local mobility significantly decreases with the number of *previous migrants* living in the household, likely due to fewer social connections within the canton.

The effects of migrant networks on mobility are generally positive as expected, but also include significant nonlinear terms and unexpected effects on other migration streams. The number of rural migrants from the household (*HH rural migrants*) has no significant effect on rural migration but intermediate numbers of rural migrants increase the probability of local mobility and large numbers increase the probability of international migration. Consistent with predictions, urban migration significantly increases with the number of urban migrants from the

household (*HH urban migrants*), but the effect decreases beyond eight migrants. The number of international migrants from the household (*HH international migrants*) had the most consistently significant effects[12], and predicted probabilities are displayed in Figure 2. International migration and local mobility peak with intermediate numbers of previous international migrants (three and one respectively), whereas urban migration increases sharply with large numbers of international migrants (beyond five) and rural migration decreases. At the community level, urban migration increases with the number of previous rural migrants from the community (*Com rural migrants*) and decreases with the number of previous international migrants (*Com international migrants*). Overall, these effects of migrant networks suggest the existence of complex tradeoffs and synergies between different forms of mobility, which are revealed by testing for nonlinear effects from social networks disaggregated by destination type (Davis et al 2002). Countering the facilitating effects of migrant networks, households likely choose to diversify the destinations of their out-migrants, leading households with many rural migrants to send an international migrant or those with many urban migrants to choose not to send another.

Among physical assets, *home ownership* has a positive significant effect on rural migration and having *electricity* has a positive marginally significant effect on urban migration (p =.053), suggesting that satisfaction of basic needs is likely to increase migration as predicted. Isolation from both local and paved roads tends to increase mobility as predicted. Distance from local roads (*distance to road*) increases local mobility and rural migration (p =.086). Community distance from paved roads (*distance to paved road*) significantly increases urban migration, but actually decreases local mobility, perhaps because the incentives to relocate locally are higher in communities near or on paved roads. The number of *services* available in the community has a significant negative effect on urban migration as predicted but no significant effects on other types of mobility, likely because individuals in poorly-serviced communities are more attracted to the many services available in urban destinations.

Agricultural and environmental assets also have important effects on mobility which substantially differ across streams as expected (Table 7). The number of cattle owned and access to land, both key measures of wealth, have nonlinear effects on mobility which are most important for rural and international migration. The effects of *cattle* ownership are displayed in Figure 2 and are jointly significant for rural and international migration. Rural migration peaks with ownership of 10 cattle and international migration increases sharply over 30 cattle, likely reflecting the relative size of investments required for these two types of mobility. The effects of land owned (*own land*) are also shown in Figure 2 and are jointly significant or marginally significant for local and international migration. These effects peak respectively at 10 and 50 hectares of land owned, again likely reflecting the wealth requirements for these different types of mobility. The effects of rented and loaned lands (*other land*) are significant only for rural migration and again peak at intermediate values. The number of agricultural *parcels*, which is a measure of land fragmentation when controls for land area are included, has a positive effect on local mobility (p =.052) and a negative effect on international migration, likely reflecting the negative implications of land fragmentation for wealth and economic standing. The particular importance of these effects for rural migration suggests that potential migrants compare opportunities for land and cattle ownership in the origin versus potential rural destinations, just as urban migration is particularly responsive to the availability of services.

[12] This predictor also likely captures effects of international migrant remittances, as a separate time-varying measure of remittances was not available.

In addition to the effects of cattle and land ownership, migration is also responsive to environmental characteristics of household lands such as topography, soil quality, and land use. As predicted, these effects are most important for local and internal migration, particularly rural migration, and less so for international migration. Contrary to expectations, urban migration increases with access to *flat land* and fertile *black soil*, suggesting that these environmental assets act as a migration-facilitating form of wealth rather than a migrant-retaining source of income and employment (see VanWey, 2005). Local mobility also significantly increases with flat land but decreases with black soil. Households which experienced erosion or nutrient depletion (*soil problems*) are more likely to send rural migrants, consistent with the environmental refugees hypothesis, but were also less likely to send international migrants (p =.097), perhaps reflecting the negative wealth implications of owning degraded land. Having land in *cash crops* retained local movers and urban migrants, and land in pasture, shrubs or forest (*extensive land use*) retained rural migrants, suggesting that land uses which provide income or opportunities for intensification discourage migration as predicted. Urban migration increased with a *bad harvest* (p =.066) and decreased with mean annual *precipitation*, also consistent with the environmental refugees hypothesis. A *good harvest* increased local mobility, possibly by affecting the timing of new household formation or movements for schooling.

Environmental characteristics at the community level also had significant effects. Steep slopes (*slope*) unexpectedly decreased rural migration, consistent with a wealth effect, but increased local mobility. Consistent with the household effects described above, local mobility was less likely (p =.086) and rural migration was more likely (p =.094) from communities with predominantly black soil (*Com black soil*). The amount of agricultural *land per person* increased local mobility and urban migration, contrary to predictions. Rather than capturing the amount of available land, this measure may reflect the "ruralness" of the community or the extent of past out-migration. The number of *agrochemicals* used in the community, which represent an opportunity for agricultural intensification, decreased rural migration (p =.069) as expected but increased local mobility (p =.056), which includes moves within the community. Overall, environmental assets have important effects on out-migration, but the direction of effects differ by the type of asset, suggesting that broad hypotheses about environmental effects on migration are unlikely to hold true.

Finally, livelihood activities also influenced migration and are particularly important for urban migration (Table 7). Urban migration decreased with individual agricultural wage work (*agricultural wage*) and increased with non-agricultural work (*other wage*), consistent with predictions for the effects of agrarian and market orientations on out-migration. International migration, in contrast, declined with non-agricultural work, which may serve as a substitute for international migration. *Temporary migration* reduced local and internal migration, likely because it serves as substitute for long-term migration. Wage labor by the household head has distinct effects from individual activities, with both forms of the head's labor (*head agricultural* or *other wage*) increasing local and internal migration and decreasing international migration. Planting *subsistence crops* had similar effects. Households with more diverse livelihood strategies, encompassing wage labor and/or subsistence crops, likely have the resources to send internal migrants but do not feel the need to participate in the most extreme form of diversification by sending a migrant abroad. Household participation in the national *cash transfer* program significantly increased local mobility, perhaps by facilitating movements for schooling and new household formation, and decreased rural migration (p =.064). Overall,

livelihood diversification appears to primarily encourage local mobility and internal migration and to mostly discourage international migration.

Discussion

Together, the results indicate that the drivers of out-migration in the study area differ substantially across migration streams. International out-migration appears to be driven primarily by differences in individual human capital and in household access to international migrant networks and wealth in the form of land or cattle. Urban out-migration is more responsive to other household characteristics including demographic composition, urban migrant networks, and livelihood activities. In contrast, rural out-migration is most responsive to agricultural and environmental assets such as land, cattle, and soil degradation, and migrants tend to be older and asset requirements lower. Finally, local residential mobility is especially influenced by demographic composition, migrant networks, and accessibility. These findings, along with other studies of migrant sorting in the developing world as cited above, suggest that hypotheses and studies attempting to explain out-migration are likely to be overly simplistic if they do not account for these differences. The specific findings for international migration suggest that attempts to develop policies to discourage international migration from Ecuador, as recently proposed by the Ecuadorian government, are unlikely to succeed given that policy variables such as community infrastructure and participation in the cash transfer program do not have significant effects and wealth variables largely have positive effects.

The results also indicate that, in addition to personal characteristics, migrant networks, and economic conditions, important influences on migration decision-making include environmental characteristics, livelihood activities and contextual factors. Contrary to the environmental refugees hypothesis, many environmental assets including soil quality and topography appear to act as forms of wealth which facilitate out-migration; thus poor environmental quality in these cases discourages migration rather than encourages it. Only soil degradation and precipitation clearly fit the environmental refugees pattern, in which poor environmental conditions lead to out-migration. Beyond primarily biophysical conditions, human use of the environment including land use and use of agrochemicals also have important influences on out-migration. These results do not rule out environmental degradation as a key underlying driver of rural out-migration, and this issue should be further addressed by future studies which combine survey, spatial, and field-based measures of environmental conditions with longitudinal information on individual mobility.

This study applied a livelihoods and contextual approach to out-migration and found that origin-area livelihood diversification primarily increases internal migration but mostly decreases international migration. Nonlinear effects of migrant networks and positive effects on other migration streams also point to a livelihoods interpretation of migration decision-making in which households rely on networks but may also choose to diversify their migrants among destinations. Moreover, the study found contextual characteristics at the community level to be important factors in out-migration, including migrant networks, accessibility and services, and biophysical conditions. Together these results reinforce the hierarchical nature of migration decision-making with key influences at individual, household, and contextual scales, as well as the role of out-migration as one household livelihood strategy among many. This study also highlights the utility of the livelihoods approach together with multilevel data collection and analysis for studies of migration, rural livelihoods, and human-environment relationships.

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Figure 1. Map of Ecuador showing study area and canton-level international out-migration propensities.

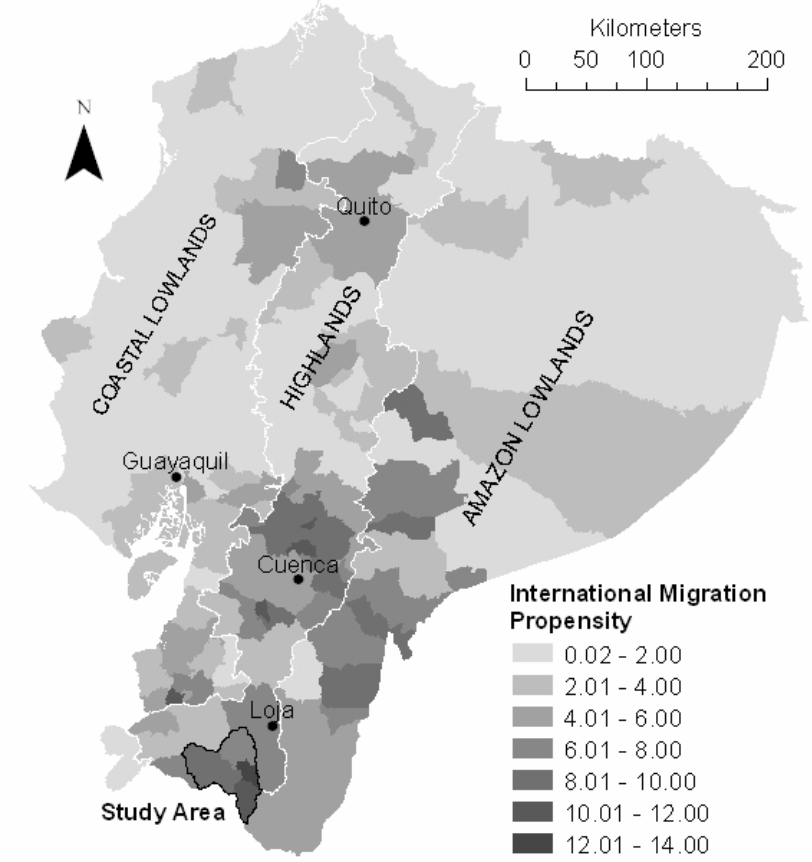

Table 1. Variable definitions and weighted mean person-year values for demographic factors predicted to influence migration.

Variable	Unit	Level	Time-varying	Mean	Definition
Female	1/0	Indiv	N	0.44	Gender is female, reference is male.
Other relation	1/0	Indiv	Y	0.13	Other relation to the HH head/s, reference is child.
Age	years	Indiv	Y	21.1	Age in March
Minors	#	HH	Y	2.64	HH members aged 0-14
Young men	#	HH	Y	1.22	Male HH members aged 15-29
Young women	#	HH	Y	0.98	Female HH members aged 15-29
Older men	#	HH	Y	1.12	Male HH members aged 30+
Older women	#	HH	Y	1.15	Female HH members aged 30+
Age of head	years	HH	Y	55.4	Age of head in March
Single head	1/0	HH	Y	0.20	Single resident head of household
Community population	#	Com	N	181	Population of community in 1995

Indiv: Individual, HH: Household, Com: Community

Table 2. Variable definitions and weighted mean person-year values for human, social and physical assets predicted to influence migration.

Variable	Unit	Level	Time-varying	Mean	Definition
Human Assets					
School	1/0	Indiv	Y	0.20	Attended school
Primary education	1/0	Indiv	Y	0.51	Had completed primary education
Secondary education	1/0	Indiv	Y	0.35	Had completed some secondary education
Head primary education	1/0	HH	Y	0.43	Head had completed primary education
Head secondary education	1/0	HH	Y	0.07	Head had completed some secondary education
Social Assets					
Short residence	1/0	Indiv	Y	0.05	Resident in community less than ten years
Previous migration	1/0	Indiv	Y	0.06	Previously resided outside of canton
Previous migrants	#	HH	Y	0.33	Adult HH members who previously lived outside the canton
HH rural migrants	#	HH	Y	0.36	Former HH members in a rural area in another canton
HH urban migrants	#	HH	Y	1.06	Former HH members in an urban area in another canton
HH international migrants	#	HH	Y	0.49	Former HH members in another country
Com rural migrants	#	Com	Y	11.0	Former community residents in a rural area in another canton
Com urban migrants	#	Com	Y	34.4	Former community residents in an urban area in another canton
Com international migrants	#	Com	Y	12.5	Former community residents in another country
Physical Assets					
Home ownership	1/0	HH	Y	0.92	Ownership of the home of residence
Electricity	1/0	HH	Y	0.62	Home has electricity
Distance to road	km	HH	N	0.71	Distance from the home to the nearest road
Distance to paved road	km	Com	N	119	Distance to the closest paved road
Services	#	Com	Y	2.67	Number of: school, daycare, electricity, piped water, store

Indiv: Individual, HH: Household, Com: Community

Table 3. Variable definitions and weighted mean person-year values for agricultural and environmental assets and livelihood activities predicted to influence migration.

Variable	Unit	Level	Time-varying	Mean	Definition
Agricultural and Environmental Assets					
Cattle	#	HH	N	3.49	Number of cattle owned in 1995
Own land	ha	HH	Y	4.78	Area of agricultural lands owned by HH members
Other land	ha	HH	Y	0.40	Area of rented and loaned lands managed by HH members
Parcels	#	HH	Y	1.53	Number of agricultural parcels managed by HH members
Flat land	1/0	HH	Y	0.34	HH managed a parcel that was predominantly flat
Black soil	1/0	HH	Y	0.57	HH managed a parcel with predominantly black soil
Soil problems	1/0	HH	N	0.59	HH experienced soil erosion or depletion in 1995
Cash crops	1/0	HH	N	0.42	HH cultivated cash crops in 1995
Extensive land use	1/0	HH	N	0.71	HH lands included pasture, shrubs or forest in 1995
Bad harvest	1/0	HH	Y	0.09	Bad harvest reported
Good harvest	1/0	HH	Y	0.05	Good harvest reported
Precipitation	cm/year	Com	N	102	Mean annual precipitation in 1km buffer
Slope	degrees	Com	N	32.0	Mean surface slope in 1km buffer
Community black soil	1/0	Com	N	0.53	Black soil predominant soil type
Land per person	ha/ person	Com	N	0.88	Hectares of agricultural lands per resident in 1995
Agrochemicals	#	Com	Y	1.01	Number used: fertilizer, pesticides, improved seeds
Livelihood Acitivities					
Agricultural wage	1/0	Indiv	Y	0.24	Performed agricultural wage work
Other wage	1/0	Indiv	Y	0.04	Performed non-agricultural wage work
Temporary migration	1/0	Indiv	Y	0.05	Left the community to work for less than six months
Head agricultural wage	1/0	HH	Y	0.42	Male head performed agricultural wage work
Head other wage	1/0	HH	Y	0.04	Male head performed non-agricultural wage work
Cash transfer	1/0	HH	Y	0.46	HH member participates in cash transfer program
Subsistence crops	1/0	HH	N	0.93	HH cultivated subsistence crops in 1995

Indiv: Individual, HH: Household, Com: Community

Table 4. Hypotheses for the effects of predictors in the event history model on migration and mobility.

Demographic Factors

1. Due to gender norms and gendered availability of employment opportunities, women will be less likely to be rural migrants and more likely to be local movers.
2. Due to lower access to household assets, household members other than the children of the household heads will be less likely to migrate.
3. Due to lifecycle factors, mobility will peak at intermediate ages both of individuals and of household heads.
4. Due to changing household labor availability and consumption demands, mobility will increase with the number of young and older adults and household heads and decrease with the number of minors.
5. Due to increased opportunities for employment and social interaction within the community, migration will decrease with population size of the community.

Human Assets

1. Due to the opportunity to continue their education, individuals enrolled in school will be less mobile.
2. Due to the increased returns to education in urban areas and differences in aspirations, educated individuals and members of households with educated heads will be more likely to migrate to urban and international destinations.

Social Assets

1. Due to mobility experience and fewer community ties, individuals resident in the community less than ten years will be more likely to migrate.
2. Due to access to social networks in destination areas, individuals and members of households with migration experience (almost all within Ecuador) will be more likely to migrate to rural and urban destinations.
3. Similarly, former household members and community residents residing in a destination will increase migration to that destination.

Physical Assets

1. Home ownership and access to electricity represent satisfaction of basic needs, which permit households to consider sending migrants, particularly to internal destinations.
2. The desire to have access to services and urban amenities will increase migration in areas isolated from roads and services.

Agricultural and Environmental Assets

1. Migration will be positively selective for wealth measured as the number of cattle, particularly international migration due to the large costs involved.
2. Land is also key measure of wealth but also a source of employment and thus has complex effects on migration. Overall, migration is likely to peak at intermediate levels of land ownership and of access to loaned and rented lands.
3. Controlling for the land area, the number of parcels is a measure of land fragmentation and is likely have a positive effect on internal migration.
4. Access to land with fertile black soil or flat topography is likely to decrease mobility. Conversely, problems with erosion and nutrient depletion are likely to increase mobility.
5. Similarly, migration is likely to decrease with higher rainfall, flatter slopes, and black soil at the community level.
6. Cash crops (primarily coffee) represent a source of income and thus should decrease migration.
7. Extensive land uses such as pasture, shrubs and forest represent an opportunity for land use intensification and should also decrease migration.
8. Good harvests should decrease pressures for livelihood diversification through migration, but might also be used to finance migration. Similarly, bad harvests could effect migration in either direction.
9. Migration is likely to decrease with land area per person in the community as it represents opportunities for agricultural intensification and new farm creation.
10. The number of agrochemicals used in the community represents opportunities for agricultural intensification and thus should decrease migration.

Livelihood Activities

1. Participation in non-agricultural wage labor by the individual or head represents labor market experience, weaker ties to own-farm activities, and access to resources which should increase migration, particularly to urban and international destinations.
2. Participation in temporary migration creates links to urban and rural destination areas but may also serve as substitute for long-term migration; thus effects could be in either direction.
3. Planting subsistence crops and participation in agricultural wage labor represent an agrarian orientation which is likely to increase rural migration and decrease international migration.

Table 5. Odds ratios from the event history analysis for the effects of demographic factors on out-migration.

Variable	Level	Local	Rural	Urban	International
Female	Indiv	1.674	0.360 *	1.085	0.696
Other relation	Indiv	0.207	0.516	0.370 **	0.711
Age	Indiv	1.581 ***	1.080	1.905 ***	2.831 **
$(Age)^2$	Indiv	0.992 **	0.999	0.987 ***	0.979 **
Minors	HH	1.378 **	1.161 *	1.073	0.829 **
Young men	HH	1.433	1.030	0.999	1.008
Young women	HH	1.711 *	1.289 +	1.473 **	1.083
Older men	HH	0.328 **	0.637	1.072	0.634 +
Older women	HH	1.279	0.752	1.652 **	0.575
Single head	HH	1.838	0.401	2.336 ***	0.922
Age of head	HH	1.008	0.815 +	0.872 **	1.137
$(Age\ of\ head)^2$	HH	1.000	1.002 +	1.001 *	0.999 +
Community population	Com	1.005 +	1.003	0.998	1.006 *

Indiv: Individual, HH: Household, Com: Community

$(Variable)^2$ represents the squared term from a quadratic fit for a continuous predictor

*** $p<0.001$; ** $p<0.01$; *$p<0.05$; + $p<0.10$

Table 6. Odds ratios from the event history analysis for the effects of human, social and physical assets on out-migration.

Variable	Level	Local	Rural	Urban	International
Human Assets					
School	Indiv	0.715	0.619	0.944	0.173 ***
Primary education	Indiv	2.058	2.843	2.644	1.607
Secondary education	Indiv	1.817	3.914	2.225	2.938 ***
Head primary education	HH	1.019	0.814	1.460 *	0.876
Head secondary education	HH	1.101	0.282 *	1.997	0.070 +
Social Assets					
Short residence	Indiv	2.613	0.545	0.175 ***	9.087 *
Previous migration	Indiv	5.110	2.325	0.889	0.056 *
Previous migrants	HH	0.155 *	0.881	1.170	1.058
HH rural migrants	HH	3.138 *	1.222	1.335	0.549 +
(HH rural migrants)^2	HH	0.826	1.027	0.908	1.170 *
HH urban migrants	HH	1.259	1.072	1.604 **	1.018
(HH urban migrants)^2	HH	0.935	1.007	0.967 *	0.973
HH international migrants	HH	14.853 ***	0.510	0.725 +	3.475 ***
(HH international migrants)^2	HH	0.268 ***	1.036	1.073 *	0.811 **
Com rural migrants	Com	0.993	1.028	1.023 **	0.981
Com urban migrants	Com	0.990	1.001	1.003	0.986
Com international migrants	Com	0.956	0.979	0.976 *	0.998
Physical Assets					
Home ownership	HH	0.356	3.650 *	1.499	1.432
Electricity	HH	1.897	0.704	1.355 +	0.663
Distance to road	HH	1.731 *	1.404 +	1.078	0.980
Distance to paved road	Com	0.996 **	1.001	1.002 *	1.002
Services	Com	0.828	1.166	0.863 *	1.060

Indiv: Individual, HH: Household, Com: Community

(Variable)^2 represents the squared term from a quadratic fit for a continuous predictor

*** $p<0.001$; ** $p<0.01$; *$p<0.05$; + $p<0.10$

Table 7. Odds ratios from the event history analysis for the effects of agricultural and environmental assets and livelihood activities on out-migration.

Variable	Level	Local	Rural	Urban	International
Agricultural and Environmental Assets					
Cattle	HH	1.059	1.147 *	1.038	0.928 *
$(\text{Cattle})^2$	HH	0.997	0.993 ***	0.998 +	1.003 **
Own land	HH	1.085	1.169 *	0.941 +	1.076 ***
$(\text{Own land})^2$	HH	0.996 +	0.994 *	1.001 +	0.999 **
Other land	HH	1.106	1.947 *	0.873	1.575
$(\text{Other land})^2$	HH	0.822	0.964 *	1.004	0.943
Parcels	HH	1.595 +	1.012	1.027	0.737 *
Flat land	HH	3.237 **	0.757	1.487 +	1.230
Black soil	HH	0.312 *	1.066	1.348 *	1.417
Soil problems	HH	1.030	2.996 ***	1.434	0.621 +
Cash crops	HH	0.265 **	0.952	0.705 **	0.725
Extensive land use	HH	1.454	0.304 ***	1.052	0.746
Bad harvest	HH	2.328	1.383	1.822 +	0.862
Good harvest	HH	5.727 *	0.885	1.437	1.564
Precipitation	Com	0.973	1.015	0.980 **	0.977
Slope	Com	1.067 *	0.925 ***	0.995	1.011
Community black soil	Com	0.558 +	1.884 +	1.185	0.638
Land per person	Com	2.157 *	1.007	1.628 ***	0.830
Agrochemicals	Com	1.572 +	0.753 +	1.073	0.958
Livelihood Activities					
Agricultural wage	Indiv	1.696	1.020	0.351 ***	1.378
Other wage	Indiv	0.834	0.460	2.021 **	0.243 **
Temporary migration	Indiv	0.193 **	0.143 *	0.308 *	0.904
Head agricultural wage	HH	2.392 **	1.620 +	1.818 **	0.327 ***
Head other wage	HH	3.020	16.737 ***	4.517 ***	0.595
Cash transfer	HH	2.392 *	0.460 +	1.116	0.762
Subsistence crops	HH	2.145	2.725 **	2.914 **	0.293 ***

Indiv: Individual, HH: Household, Com: Community

$(\text{Variable})^2$ represents the squared term from a quadratic fit for a continuous predictor

*** $p<0.001$; ** $p<0.01$; *$p<0.05$; + $p<0.10$

Figure 2. Predicted probabilities of out-migration by (1) age of the individual, (2) number of previous international migrants from the household, (3) cattle owned by the household, and (4) area of lands owned by the household, with the mean baseline hazard from 1996-2005. Clear data points indicate effects which are not jointly significant at $\alpha = 0.10$.