Published in final edited form as:
Glob Planet Change. 2005 July 1; 47(2): 99–110. doi:10.1016/j.gloplacha.2004.10.005.

Gender-specific out-migration, deforestation and urbanization in the Ecuadorian Amazon

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Abstract

The Ecuadorian Amazon, one of the richest reserves of biodiversity in the world, has faced one of the highest rates of deforestation of any Amazonian nation. Most of this forest elimination has been caused by agricultural colonization that followed the discovery of oil fields in 1967. Since the 1990s, an increasing process of urbanization has also engendered new patterns of population mobility within the Amazon, along with traditional ways by which rural settlers make their living. However, while very significant in its effects on deforestation, urbanization and regional development, population mobility within the Amazon has hardly been studied at all, as well as the distinct migration patterns between men and women. This paper uses a longitudinal dataset of 250 farm households in the Northern Ecuadorian Amazon to understand differentials between men and women migrants to urban and rural destinations and between men and women non-migrants. First, we use hazard analysis based on the Kaplan–Meier (KM) estimator to obtain the cumulative probability that an individual living in the study area in 1990 or at time *t*, will out-migrated at some time, *t*+*n*, before 1999. Results indicate that out-migration to other rural areas in the Amazon, especially pristine areas is considerably greater than out-migration to the growing, but still incipient, Amazonian urban areas. Furthermore, men are more likely to out-migrate to rural areas than women, while the reverse occurs for urban areas. Difference-of-means tests were employed to examine potential factors accounting for differentials between male and female out-migration to urban and rural areas. Among the key results, relative to men younger women are more likely to out-migrate to urban areas; more difficult access from farms to towns and roads constrains women's migration; and access to new lands in the Amazon–an important cause of further deforestation–is more associated with male out-migration. Economic factors such as engagement in on-farm work, increasing resource scarcity–measured by higher population density at the farm and reduction in farm land on forest and crops–and increase in pasture land are more associated with male out-migration to rural areas. On the other hand, increasing resource scarcity, higher population density and weaker migration networks are more associated with female out-migration to urban areas. Thus, a "vicious cycle" is created: Pressure over land leads to deforestation in most or all farm forest areas and reduces the possibilities for further agricultural extensification (deforestation); out-migration, especially male out-migration, occurs to other rural or forest areas in the Amazon (with women being more likely to choose urban destinations); and, giving continuing population growth and pressures in the new settled areas, new pressures promote further out-migration to rural destinations and unabated deforestation.

Keywords

Ecuadorian Amazon; out-migration; gender differences; deforestation; urbanization

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1. Introduction

The Ecuadorian Amazon, one of the richest reserves of biodiversity in the world (Myers et al., 2000), has faced one of the highest rates of deforestation of any Amazonian nation, with huge losses of biodiversity and natural resources (FAO, 2001). Most of this forest elimination has been caused by agricultural colonization that followed the discovery of oil fields in 1967.

Recent evidence indicates profound changes in population mobility in areas of agricultural colonization in the Ecuadorian Amazon frontier. Following the earlier large-scale migration influxes from long-settled regions, the most dramatic forms of population mobility under way are currently within the frontier. Rural plots have, on average, become much smaller in the 1990s, from 45.9 ha in 1990 to 25.3 ha in 1999 as a consequence of population growth–continuing in-migration and high fertility–which generate a demand for land that exceeds the limited supply in the traditional areas of occupation (Barbieri et al., 2003). In particular, the Total Fertility Rate–TFR–in the Amazon was 5.5 children per woman in 2000 (CEPAR, 2000). Thus, more and more rural households see permanent out-migration of one or more family members as a way of earning cash income and diversifying risk. This strategy helps alleviate dependence on dwindling forest resources. As farms have atrophied over time, primary forests within farms have become scarce in the study area in the Ecuadorian Amazon: While farms had, on average, 59% of their lands on forests in 1990, this proportion declined to 45% in 1999 (Barbieri et al., 2003).

In addition to deforestation on original farms, population surpluses in traditional frontier areas in the Ecuadorian Amazon have moved to less occupied or unoccupied areas, engendering further deforestation. Furthermore, rural–urban mobility has led to increasing urbanization, with recent growth among long-settled river towns, formation of new pioneer urban areas, and the incipient transformation of many rural communities, which are acquiring urban characteristics through population growth and acquisition of basic infrastructure. Increasing economic and social articulation is also evolving between larger and smaller urban communities, constituting an incipient but increasing and complex network of urban places in the Amazon. Urban growth in the Amazon has occurred without correspondent improvements in infrastructure, such as sanitation, garbage disposition and treated water, and accessibility to health and family planning facilities.

While very significant in its effects on deforestation and urbanization, population mobility within the Amazon has hardly been studied. Furthermore, the gender dimension involved in migration patterns, another neglected issue in the empirical literature on population living in rural areas of the developing world (Radcliffe, 1991; Chant and Radcliffe, 1992; Lawson, 1998; Deere and Leon, 2003), can be regarded as crucial to understand processes of land use, population redistribution, urbanization and deforestation in places such as the Amazon. Previous work in our study area suggests that important gender differences exist between migrants. For example, young women are more likely than young men to leave their parent's households and to choose urban destinations in order to marry, study or work, while men are usually less mobile and are more likely to engage in farm work (Laurian et al., 1998). Radcliffe (1992) also suggests that women tend to out-migrate more from rural areas in the Peruvian Andes to larger towns, while men tends to migrate more to rural and intermediate urban areas.

Social and cultural factors are also likely to play a key role in defining gendered migration in the Amazon. In particular, intra-household gender differences engendering migration should be understood in the context of cultural and historical processes operating at specific places (Lawson, 1998). The high mobility of younger and unmarried women in Latin America, especially to urban areas, is likely to be explained by the "social construction of female labor"

as a marginal one, having small usefulness in extra-household work (Radcliffe, 1991). Chant and Radcliffe (1992) suggest that migration networks and links between migrants and areas of origin in Latin America tend to be more important for married women, since they usually attach more value to family and community ties than men. As a result, "while women might migrate as individuals, decisions on their movement may be strongly circumscribed by other members of the family unit or kin" (p. 14-5). Chant (1992) also associates a higher predominance of female rural–urban migration in Costa Rica to family, rather than individual, strategies which do not necessarily aim to maximize income. Women supports the migration of other household members (especially husbands, older brothers, sons and daughters) as a mechanism to provide better access to services such as education, health and housing.

The hypothesis in this study is that characteristics of household members, as well as transportation infrastructure linking farms to towns and roads, and characteristics of farm households, are different between men and women migrants and non-migrants in ways that predict gender-specific migration destinations. This hypothesis is predicated on the notion that agricultural extensification and population growth in the Amazon generates increasing demand for new agricultural land and an increasing pattern of land fragmentation. This demand is partially met through migration to new agricultural frontiers. Since young men are more likely than young women to out-migrant to other rural areas in the Amazon, this migration gender imbalance is likely a key component behind forest conversion that has been ignored in previous studies. Conversely, a key to understanding the rapid urbanization of the Ecuadorian Amazon is to examine how rural transformations in the frontier and rural–urban articulations have engendered higher impact on female rural out-migration compared to male out-migration. In this study we examine differences between men and women migrants to rural and urban destinations and differences between men and women non-migrants.

2. Study area

The colonist study area is located in the western Amazon Rain Forest, and in the Northern Ecuadorian Amazon. Together with the Coastal region and the Highlands ("Sierra"), the Ecuadorian Amazon (a region also known as the "Oriente") represents the three distinct landscapes of the country (Fig. 1).

The study area is a sparsely populated tropical lowland rainforest. The altitude varies from the Andean foothills to about 200 m above sea level, with the study area 350–250 m, straddling the Equator, with annual rainfall of 3–5 m. Soil conditions are generally better than in the lower Amazon of Peru or Brazil, as a result of pockets of volcanic (black) soils, although soil quality is highly variable and much is poor quality red soils with high acidity and aluminum toxicity. The Ecuadorian Amazon offers a year-round growing season, with rain occurring in all 12 months, and thus allowing the use of slash and mulch clearing practices (cutting trees and leaving them to decompose), with little burning of trees or agricultural residues such as in the Brazilian Amazon. Nevertheless, by the late 1990s there appeared evidence of micro-climatic changes in some areas, perhaps due to the loss of vegetation, resulting in drier conditions in certain months.

The study area began to be occupied by agricultural settler families after the discovery of oil in 1967, which was followed by the laying of pipelines and a road network for the exploitation of oil, and by the establishment of town of Lago Agrio. From the mid-1970 to the present, the oil exploited in the study area in the Northern Amazon has been responsible for half or more of both foreign exchange earnings and government revenues in Ecuador. Despite being extensively occupied by agricultural settlers, the region still attracts migrants from other parts of Ecuador, especially the Sierra. Virtually all of the colonization in the Ecuadorian Amazon has been spontaneous, with most of the colonists being poor and arriving without capital to

invest in their plots, and facing a lack of infrastructure and governmental assistance. In fact, the Ecuadorian government has historically relied on “laissez-faire” policies towards the Amazon, with few limitations or regulations to the development of the oil industry, and no directed efforts towards planning agricultural colonization (Bilsborrow, 1998).

As a consequence of this colonization process and oil extraction activities, the Northern Amazon study region has experienced high rates of deforestation, with forest cover on sample farms falling from virtually 100% in the 1960s to 59% in 1990, and further to 45% in 1999. There are now four main towns in the study area: Lago Agrio (the largest, with 34,000 people, according to the 2001 Ecuadorian census), Coca, Joya and Sushufindi. The total population in the Ecuadorian Amazon in 1990 was 384,582—4% of the Ecuadorian population (INEC, 1992). The population in 2001 was about 550,000—5% of the Ecuadorian population, following 30% growth over 1990–1999 vs. 22% nationally (INEC, 2001).

3. Data and methods

Farm households in the study area were selected in 1990 using a two-stage cluster sample. The 1990 survey was conducted by Francisco Pichón and Richard Bilsborrow (who also conducted a follow-up survey in 1999) from The University of North Carolina at Chapel Hill. Pichón and Bilsborrow used crude maps and lists of approved settlement areas in the northern Amazon, from which they obtained a sample frame of sectors (settlement areas), with each sector comprising a number of farm households. The sampling frame contained the total number of farm households for all sectors, and was used to select systematically a sample of 64 sectors from the nearly 300 in the region. In the second stage, a cluster of 5–10 contiguous farm households was randomly selected from each of the selected sectors, based on the size of the sector, to achieve a PPS probability sample. Through this process, 418 farm households were selected, which represented a 5.9% sample of the rural population of the Northern Ecuadorian Amazon.

In 1999, a follow-up survey was conducted and the same plots of land in 1990 were visited, which required interviewing all the farm households on any of the subdivisions of the original plots. Through an inspection of each questionnaire in 1990 and 1999, 250 farm households were identified for which the head of the household and/or his spouse was the same in 1990 and 1999. Thus, it is possible to identify 2086 individuals (54% men and 46% women) living at any point during the 1990s in the 250 nuclear households surveyed in 1990 in 1999. This number includes those who were born, died or out-migrated during the decade.[1]

Out-migrants are defined as those individuals between 12 and 59 years of age who left the farm household permanently to live in a rural or urban area elsewhere between 1990 and the interview date in 1999. The Kaplan–Meier (KM) estimator, or alternatively product-limit estimator (Allison, 1995), gives the cumulative probability that an individual living in the study area at time t (t=1990,…,1998), out-migrated at some point, $t+n$, before or during 1998:[2]

$$OM(t)=\prod_{tj:tj\leq t}\left[d_j{}^{*}n_j^{-1}\right] \quad (1)$$

[1]A total of 1778 individuals were living in the farm households in 1990, and 308 were born after the 1990 survey and before the 1999 survey.

[2]Since data was collected during the first semester of 1999, it does not include all out-migrants in this year (from January 1 to December 31). Thus, data for 1999 was not included in the KM estimator.

where OM(t) represents the cumulative probability, at time t, that an individual will out-migrate and Π represents the sum of all events (i.e., out-migration) that are less than or equal to t. The subscript j represents a specific year, j=1=1990, j=2=1991 and so on; d_j represents the number of out-migrants at time j, and n_j represents the number of individuals at risk of out-migration at time j.

Out-migration is measured as a multinomial variable, indicating if an individual did not move, moved to an urban area, or moved to a rural area. In order to understand possible factors affecting out-migration differentials according to destination and gender, variables mentioned in the literature as determinants of out-migration in frontier areas are identified and analyzed through difference-of-means tests, which estimate the significance of the difference between men and women for a specific variable. Thus,

$$t(X_f - X_m) = (X_f - X_m)/\sigma(X_f - X_m) \quad (2)$$

$$\sigma(X_f - X_m) = \sqrt{[(s_f^2/n_f - 1) + (s_m^2/n_m - 1)]} \quad (3)$$

with t (X_f–X_m) representing the difference-of-means test. Subscripts f and m represent, respectively, females and males, and X represents the mean for a given variable. $\sigma(X_f$–$X_m)$ represents the unequal variance between males and females; this inequality should be assumed given the large sample size in this study. That is, since the population of men and women for a specific out-migration status does not have equal standard deviations, variances for men and women must be estimated separately. Symbols s and n represent, respectively, the standard error and sample size for X, according to gender.

The means for the variables in Eqs. (2) and (3) represent demographic and individual attributes affecting out-migration, as well as farm household characteristics and the transportation network linking farms to towns and roads in the region.

4. Results

4.1. Out-migration by gender and destination

Table 1 shows the number and percentage of out-migrants between 12 and 59 years of age over the period 1990–1999, according to their place of destination and gender. Most of the 250 farm households in the study area (147 or 59% of the total) had at least one out-migrant between 1990 and 1999, with a similar number between farm households with at least one male or one female out-migrant. Men represented 58% of all out-migrants in this period, compared to 42% women. Most of the out-migrants in the study area choose rural destinations (68%), with men being more likely to move to rural areas than women (42% vs. 26% of total out-migrants). Rural–urban migration is relatively more important for women when compared to men; despite comprising a smaller proportion of the total number of out-migrants compared to men (42%), women had the same proportion of out-migrants choosing urban destinations (16%). In fact, while the ratio of those choosing rural destinations instead of urban destination is 2.7 for men (42.2% divided by 15.7%), the ratio is 1.6 for women. Important gender differences are also noticed when considering age groups. Male out-migrants are more evenly distributed between age groups 12–19 and 20–34 for both rural and urban destinations, while female out-migrants are more concentrated in the youngest age group, especially for those choosing urban destinations. The relatively smaller proportion of female out-migrants between 20 and 34 years of age probably reflects smaller employment opportunities in urban areas for older (and most

likely married) women, as well as the transition to an out-migration pattern in which female mobility, especially to rural areas, is more associated with family migration (that is mobility tied to spousal or familial migration).

Fig. 2 illustrates the dynamics of out-migration between 1990 and 1998. It shows, by gender and destination, the annual cumulative probabilities of out-migration from the Ecuadorian Amazon between 1990 and 1998. While urbanization is a growing process in the Amazonian study area, Fig. 2 shows that most of the out-migrants choose rural destinations in other areas in the Amazon, thus engaging in further deforestation, exacerbated by a male bias for rural out-migration. While the cumulative probability that a man between 12 and 59 years of age living in the study area in 1990 will out-migrate to a rural area by the end of 1998 is 24%, the probability for a woman between 12 and 59 years of age is 19%.

Conversely, compared to men, women between 12 and 59 years of age living in the study area in 1990 are more likely to out-migrate to urban areas (15–12%) by the end of 1998, probably due to the availability of female-dominated domestic employment and employment in the tertiary sector, or migration due to family reasons—for example, the female spouse living in town with children pursuing education, or providing domestic work, to family members working in a town.

4.2. Factors associated with out-migration

Table 2 presents means, standard deviations and difference-of-means tests for demographic and individual attributes potentially affecting out-migration from the study area in the Ecuadorian Amazon between 1990 and 1999, when controlled by out-migration destination and gender. Younger people, especially between 16 and 25 years of age, traditionally are the most likely migrants, irrespective of spatial and temporal contexts (Ravenstein, 1889;Lee, 1966;Bilsborrow et al., 1984;Laurian et al., 1998;VanWey, 2003). Consistent with the migration literature, the results show that the mean age for out-migrants is considerably lower compared to non-migrants, especially among women. The highly significant difference-of-means between men and women suggest that women are more likely to out-migrate at younger ages compared to men, especially to urban destinations.

Number of persons in the household varies relative to out-migration outcomes. Table 2 shows significant differences between men and women relative to household size; especially notable is the higher means among out-migrants choosing rural areas compared to those choosing urban areas. Male out-migrants to rural areas come from larger households than women, while the choice for an urban destination does not seem to be related to household size differences. Lastly, women who do not move are more likely to live in larger households than men.

Engagement in farm work measures if an individual who lived in the farm household was fully engaged in farm work during the 1990s or, conversely, if he/she was not usually engaged in farm work during the 1990s. We anticipate that lack of engagement in farm work should have a positive effect on out-migration, since it means the desire (or necessity) for employment alternatives to on-farm work. The difference between men and women is highly significant for both out-migrants and those not moving, indicating evidence of traditional gender roles, with women being more engaged in domestic or auxiliary work on the farm and men being more engaged in on-farm work. Male out-migrants to rural areas had substantially more on-farm experience compared to men choosing urban areas, revealing a linkage between a higher rural employment background and out-migration to other rural areas. Women are overall less engaged in on-farm work, regardless of being an out-migrant or not.

Household's head education measures the general household human capital (VanWey, 2003), and indicates the influence of the (usually male) household head's education on shaping

other household members' decision to out-migrate. It represents the head's capacity to assimilate information about employment opportunities elsewhere and transmit them to household members. The difference-of-means test is significant only for out-migrants. Men were significantly more likely than women to out-migrate from households where the household head studied at the secondary school level, showing their better ability to benefit from a higher household human capital.

Number of previous migrants measures the number of former household members who out-migrated from the farm household before a given time, *t*. Previous migration experiences in the household is likely to engender further mobility of household members due to their effect on personal aspirations in terms of welfare and income, and by creating a network of socioeconomic support and information between former out-migrants and potential out-migrants (see Massey, 1990). The means for non-migrants are substantially lower compared to those out-migrating, suggesting an important association between out-migration and number of previous out-migrants from the farm household. Male out-migrants to urban areas come from households with a significantly higher number of previous out-migrants compared to women. This suggests that a smaller number of previous out-migrants are sufficient to affect women's decision to move to urban areas relative to men.

Table 3 shows differences in farm household characteristics and transportation infrastructure linking farms to towns and roads in the region, when controlled by out-migrants destination and gender. *Population density at the farm* (proportion of the number of people living on the farm relative to the farm area) measures the farm capacity to sustain household members, for a given amount of land and population living on the farm. A higher number of persons in the household for a fixed amount of land over the years can mean smaller returns to labor, and thus increased out-migration pressure (see, e.g., Walker and Homma, 1996;Perz, 2001;McCracken et al., 2002;Moran et al., 2003). Farms in the study area are likely to be smaller over the years as fathers divide their original farm among heirs–especially men–and these in turn apportion land among their respective heirs. The longer a family lives on the farm, the higher the risk of having a smaller farm due to subdivisions, and thus the higher the risk of out-migration. The results show a highly significant difference-of-means when considering out-migrants choosing urban destinations based on population density. Women moving to urban areas are much more likely to come from farms with higher population density, while men out-migrate, on average, from farms with lower population density. The difference-of-means test is less significant when considering out-migration to rural areas or those not moving, and shows that women are more likely to out-migrate to rural areas at lower population densities compared to urban areas.

Two variables measure the transportation infrastructure physically linking farm households to towns and roads in the study area: *Walking distance to the nearest road* and *Distance to the nearest town*. Better and shorter access to towns and roads implies more possibilities of circulation and/or out-migration of household members looking for work, a marketplace, services or facilities in local towns, and facilitates communication and travel. The difference-of-means for *Distance to the nearest road* is significant only for those choosing rural destinations; male out-migration is associated with a significantly greater walking distance compared to women. It is likely that more difficult access to roads constitute a greater physical barrier for women, whose migration behavior is associated with shorter walking distances. Regarding *Distance to the nearest market*, men seem to be more likely to out-migrate from farm households at greater distances from markets compared to women, both for rural and urban destinations, while this difference is only marginally significant when considering those not moving. This result, as well as walking distance, suggests that transportation infrastructure is likely to be a key factor constraining female's out-migration.

Difference in amount of land measures the amount of land in a farm dedicated to crops, pasture or forest in 1999, compared to 1990. A negative value indicates that the amount (ha) of a specific land use in 1999 is, on average, smaller compared to the amount of land in 1990. The fact that all but one land use, according to gender and out-migration destinations, have negative values reflects the important process of land subdivision in the study area during the 1990s, with farm households in 1999 having, on average, less land available for any particular use. Nonetheless, one can see that higher declines occurred for forests and crops, while a smaller decline, or even an increase, occurred in the amount of land in pasture, suggesting that the latter is an increasingly preferred land use. This pattern recurs in other areas of tropical forests, especially the Brazilian Amazon (Hecht, 1983; Walker et al., 2000).

Among out-migrants, the difference-of-means in amount of land in crops is significant only for those choosing urban areas. Crops are associated with family subsistence production, and women moving to an urban area come, when compared to men, from farms with a higher decline in cropland. On the other hand, women not moving are more likely to live in farms with a smaller decline in the amount of land on crops, compared to men.

The only significant difference-of-means for amount of land in pasture occurs for out-migrants choosing urban destinations, which also represents the only situation of increase in the amount of land according to gender and out-migration status. Men are more likely to out-migrate from farms with a higher increase in the amount of land on pasture, reflecting an association between wealth and urban migration. A smaller amount of land in forest seems to affect out-migration decisions differently between men and women: while men choosing rural destinations come from farms loosing more forest, a smaller amount of land on forest seems to be associated with a higher female out-migration to urban areas compared to men. Men are traditionally more engaged in rural activities, and as possibilities for continued agricultural extensification–converting forests into agricultural land or pasture–dwindles due to increasing pressures on available land, out-migration to other rural areas in the Amazon is a likely consequence, while women are more likely to move to urban areas. However, this rural migration response among men occurs more frequently among men without pasture land, and therefore capital, which is associated with a greater socio-economic capital which would select for urban migration.

5. Conclusions and discussion

This paper shows the importance of a longitudinal analysis in illuminating an important, yet neglected dimension of studies on land use and migration in Latin America. Exploring gender differentials in out-migration destinations allows a more nuanced understanding of processes engendering further deforestation and increasing urbanization in the Amazon.

As population grows, with second or third generation of settlers demanding more land and new in-migrants arriving to the Ecuadorian Amazon and with decreasing possibilities of improving agricultural outputs through agricultural extensification, land in traditional colonization areas becomes increasingly scarce over the years, and out-migration becomes an alternative for younger household members. This paper suggests that increasing resource scarcity–as indicated by higher numbers of people living in the household, higher population density at the farm, and decreasing amounts of land in forest and crops–is associated with male out-migration to rural areas, and female out-migration to urban areas. Thus, a “vicious cycle” is created: Pressure over land leads to deforestation in most or all farm forest areas and reduces possibilities for agricultural extensification; out-migration, especially male out-migration, becomes channeled to other rural or forest areas in the Amazon (with women more likely to choose urban destinations than men); and, given continued population growth in the newly settled areas, population pressures will engender further out-migration and unabated

deforestation (Barbieri, 2003). Further exacerbating this process is the fact that household size is greater among rural migrants, thus creating greater population momentum.

Evidence of men breaking out of this rural migration cycle is revealed in the data in that men with increasing pasture on the farm, a proxy for increased wealth status, are more likely urban migrants. The socio-economic benefits accrued through wealth are many, including better education and different aspirations, many of which will select for urban migration. This adds an important dimension to the debate on frontier land use. The much-maligned cattle rancher, while typically clearing much more forest than the typical crop farmer, is because of an urban migration proclivity, perhaps less destructive of the forest over time.

Cumulative probabilities of out-migration between 1990 and 1998 show that out-migration to rural areas is more likely than to urban areas, but with a distinct gendered pattern—men were more likely to out-migrate to other rural areas between 1990 and 1998, and women were more likely to out-migrate to urban areas in the same period. This result suggests that gender imbalances in motivations to out-migrate are a key driver behind out-migration and, ultimately, forest conversion and frontier urbanization. These processes remain unexamined in previous empirical literatures which focus on more aggregate and cross-sectional analyses, and do not clarify the importance of factors operating at the farm household level over time.

Individual, infrastructure, and demographic factors are particularly important in female out-migration. For example, female out-migrants are essentially selected from younger ages, as suggested by Laurian et al. (1998). Women seem more likely to move in the absence of strong migration networks (measured by the number of previous out-migrants in the household). Transportation infrastructure is also a particularly important factor in women's mobility, since it facilitates out-migration to towns for housework, activities such as retail and informal work, or to accompany school-age children.

On the other hand, economic and land use factors are particularly important to understand male out-migration. For example, pasture is a less labor-demanding activity compared to crops, thus releasing male labor to urban areas. Further, male out-migration can respond to capital accumulation strategies, with male urban employment a means to accumulate capital to invest in cattle. Better transportation infrastructure, including new roads, also means more access to new settlement areas, especially for men or married couples. Easier access to new lands in the Amazon especially through male out-migration is very likely to promote further deforestation; this finding corroborates the link between deforestation and road accessibility noted thoroughly in the literature (e.g., Rudel, 1983; Nelson and Hellerstein, 1997).

The results also suggest that some drivers of gendered out-migration differentials result from women's marginal household bargaining power. Women usually leave their homes to live elsewhere when marrying or in order to marry since, among other factors, they are usually less privileged in the share of limited resources, having more limited access to land and farm work compared to men, as suggested in previous studies (Radcliffe, 1991; Lawson, 1998). The association between female out-migration and a smaller proportion of women engaged in on-farm work (when compared to men) reflects their small participation in farm household strategies regarding labor allocation. Further research would benefit from an understanding of how this migration pattern results from specific social and cultural processes operating in rural areas of the Ecuadorian Amazon.

Finally, the results suggest the necessity of a revision in national policies regarding population redistribution and its effects on urbanization and deforestation in the Amazon. " Laissez-faire" or permissive policies may have proven effective for government geopolitical purposes of occupying the Amazon, relieving land pressures and assuaging conflicts in the most densely populated areas in the country (especially in the Sierra). They may also have contributed to

generating royalties from oil activities. However, recent transformations in the frontier, with population growth and redistribution engendering mounting pressures on existing forests and on urban infrastructure, demand a more active policy role. It is necessary, for example, to address family planning, as a way to reduce population pressure on resources, measures to improve living conditions in long-settled rural areas, and to improve infrastructure and labor opportunities in urban areas, especially for younger women.

The probable implications of these policies would be to reduce out-migration to areas of pristine forests in the Amazon, thus sundering the "vicious cycle" of deforestation on the frontier, while simultaneously providing better employment opportunities and living standards in urban areas, especially for younger women. It will be crucial to develop a long-term planning perspective to anticipate specific demands for a population entering a life cycle stage in which the demand for land or urban employment is higher.

These are among the key, under examined elements to be addressed in furthering research regarding deforestation and urbanization in the Amazon frontier. Future research would fruitfully probe remaining questions by comparing statistical differences not only between genders but also among migration destinations with longitudinal models to examine the relative magnitude of various household and farm characteristics relative to gendered destination choices.

Acknowledgments

This work is based on a project of the Carolina Population Center (CPC), Department of Geography, and Department of Biostatistics at the University of North Carolina in Chapel Hill, in collaboration with EcoCiencia, a leading non-profit ecological research organization in Quito, Ecuador, Richard E. Bilsborrow and Stephen J. Walsh Principal Investigators. Major funding for this research was provided by the US National Aeronautics and Space Administration (NASA) (NCC5-295). The authors thank Brian Frizzelle (SAU/CPC); Jasper Grosskurth; and START for all the support regarding the presentation of an earlier version of this paper at the "International Young Scientists' Global Change Conference", in November 2003 in Trieste, Italy. Thanks also to two anonymous reviewers for the comments on an earlier version of this paper.

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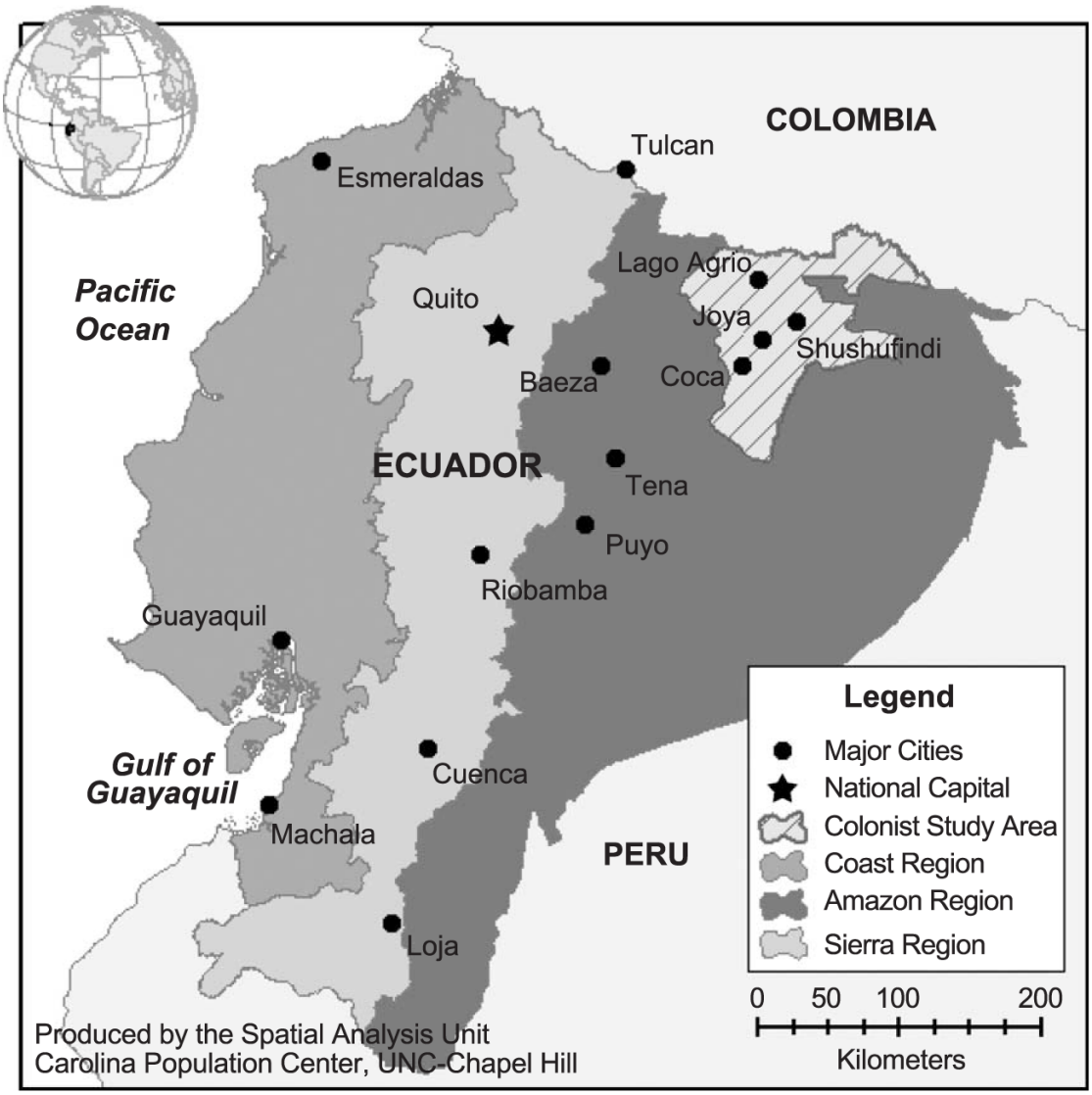

Fig. 1.
Study area in the Northern Ecuadorian Amazon.

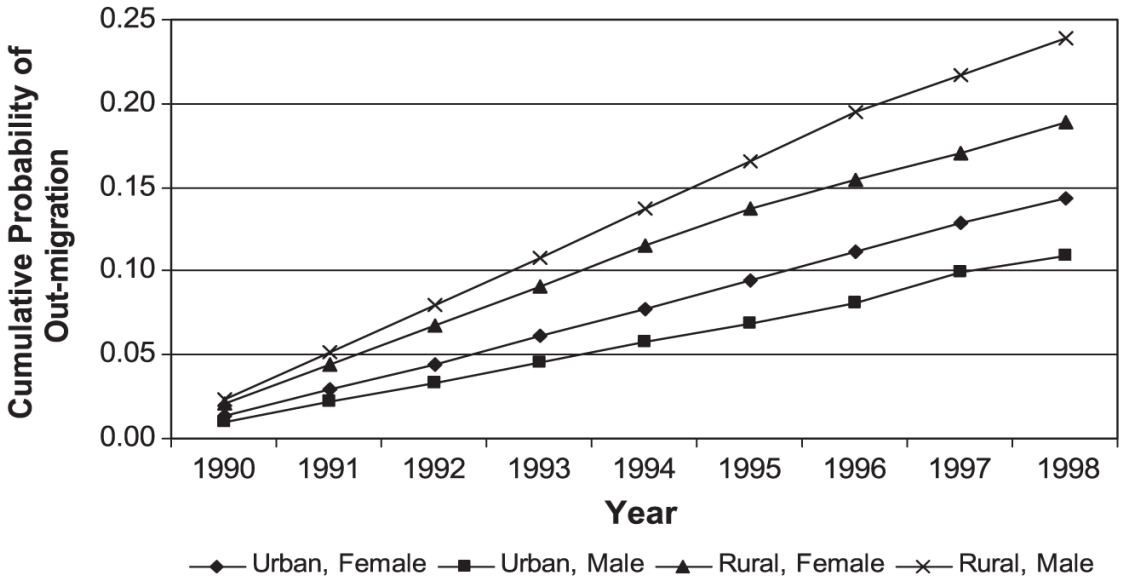

Fig. 2.
Cumulative probability that an individual will out-migrate from the farm household in the Northern Ecuadorian Amazon between 1990 and 1998, according to place of destination and gender.

Table 1

Total number of permanent out-migrants between 12 and 59 years of age from the Northern Ecuadorian Amazon, between 1990 and 1999, according to place of destination, gender, and age group

	Number of households with out-migrant(s) (total=250 households)	Total		Rural		Urban	
		Out-migrants, *N*	Out-migrants, % of total	Out-migrants, *N*	Out-migrants, % of total	Out-migrants, *N*	Out-migrants, % of total
Male	110	203	57.8	148	42.2	55	15.7
12–19 years old		94	26.9	67	19.1	27	7.7
20–34 years old		88	25.1	66	18.8	26	7.4
34–59 years old		20	5.8	15	4.3	2	0.6
Female	116	148	42.2	92	26.2	56	16.0
12–19 years old		100	28.6	61	17.4	41	11.7
20–34 years old		40	11.4	26	7.4	13	3.7
34–59 years old		8	2.2	5	1.4	2	0.6
Total	147	351	100.0	240	68.4	111	31.6

Table 2

Means, standard deviations and difference-of-means test[a] of variables measuring individual attributes and demographic characteristics in the Northern Ecuadorian Amazon, 1990–1999, according to gender and out-migration destination

Variable	Rural out-migrants		Urban out-migrants		No-out-migrants	
	Female mean (S.D.)	Male mean (S.D.)	Female mean (S.D.)	Male mean (S.D.)	Female mean (S.D.)	Male mean (S.D.)
Age	20.16 (8.15)	23.35*** (8.91)	18.52 (5.84)	21.35*** (6.87)	30.48 (13.66)	29.49*** (14.08)
Number of persons in the household	8.90 (5.02)	9.35* (5.01)	7.53 (2.88)	7.35 (2.70)	8.13 (4.45)	7.72*** (4.22)
Engagement in farm work (1=engaged, 0=not engaged)	0.56 (0.50)	0.92*** (0.28)	0.51 (0.50)	0.83*** (0.38)	0.56 (0.50)	0.82*** (0.38)
Household's head education (1=at least some secondary)	0.32 (0.47)	0.38** (0.48)	0.29 (0.46)	0.38** (0.49)	0.41 (0.49)	0.41 (0.49)
Number of previous out-migrants in the household	1.94 (2.56)	1.98 (2.34)	1.99 (2.46)	2.30* (2.51)	1.52 (2.17)	1.67*** (2.25)

[a] Difference-of-means test (Cochran method) between males and females are showed in the column with results for males.

* $p<0.10$ (two-tailed test).

** $p<0.05$ (two-tailed test).

*** $p<0.01$ (two-tailed test).

Table 3

Means, standard deviations and difference-of-means test[a] of variables measuring farm household characteristics and transportation infrastructure in the Northern Ecuadorian Amazon, 1990–1999, according to gender and out-migration destination

Variable	Rural out-migrants		Urban out-migrants		No out-migrants	
	Female mean (S.D.)	Male mean (S.D.)	Female mean (S.D.)	Male mean (S.D.)	Female mean (S.D.)	Male mean (S.D.)
Population density at the farm (people per ha)	0.22 (0.13)	0.23** (0.14)	0.36 (0.74)	0.22*** (0.21)	0.24 (0.34)	0.23* (0.32)
Walking distance to the nearest road (km)	0.68 (1.29)	0.98** (1.60)	0.64 (1.36)	0.73 (1.37)	0.88 (1.45)	0.83 (1.45)
Distance to the nearest market (km)	23.82 (15.03)	27.31*** (17.76)	24.44 (19.53)	27.20** (18.88)	26.42 (16.57)	27.06* (17.76)
Difference in amount of land in crops, 1999–1990 (ha)	−7.86 (6.46)	−7.92 (5.78)	−7.86 (6.42)	−7.00** (5.33)	−8.62 (6.35)	−8.87* (6.68)
Difference in amount of land in pasture, 1999–1990 (ha)	−2.73 (40.16)	−0.51 (14.72)	4.61 (11.48)	5.75** (14.85)	−1.80 (33.79)	−1.80 (35.41)
Difference in amount of land in forest, 1999–1990 (ha)	−10.94 (19.13)	−17.31*** (41.74)	−11.55 (21.24)	−8.32** (19.22)	−9.02 (23.04)	−8.99 (28.06)

[a] Difference-of-means test (Cochran method) between males and females are showed in the column with results for males.

* $p<0.10$ (two-tailed test).

** $p<0.05$ (two-tailed test).

*** $p<0.01$ (two-tailed test).

Glob Planet Change. Author manuscript; available in PMC 2009 August 4.