Published in final edited form as:
Popul Environ. 2010 ; 32(2): 109–136. doi:10.1007/s11111-010-0119-8.

Environmental Change and Out-Migration: Evidence from Nepal

Douglas S. Massey,
Office of Population Research, Princeton University, Princeton, NJ 08544

William G. Axinn, and
Population Studies Center, University of Michigan, 426 Thompson St, Ann Arbor, MI 48106–1248

Dirgha J. Ghimire
Population Studies Center, University of Michigan, 426 Thompson St, Ann Arbor, MI 48106–1248

Douglas S. Massey: dmassey@princeton.edu; William G. Axinn: baxinn@isr.umich.edu; Dirgha J. Ghimire: nepdjg@isr.umich.edu

Abstract

Scholars and activists have hypothesized a connection between environmental change and out-migration. In this paper we test this hypothesis using data from Nepal. We operationalize environmental change in terms of declining land cover, rising times required to gather organic inputs, increasing population density, and perceived declines in agricultural productivity. In general, environmental change is more strongly related to short- than long-distance moves. Holding constant the effects of other social and economic variables, we find that local moves are predicted by perceived declines in productivity, declining land cover, and increasing time required to gather firewood. Long-distance moves are predicted by perceived declines in productivity, but the effect is weaker than in the model of short-distance mobility. We also show that effects of environmental change vary by gender and ethnicity, with women being more affected by changes in the time required to gather fodder and men by changes in the time to gather firewood, and high caste Hindus generally being less affect than others by environmental change.

Keywords

Environment; Population; Migration; Land cover; Agricultural productivity

Among social scientists seeking to model human migration theoretically and study it empirically, attention has generally focused on economic, social, and to a lesser extent, cultural factors. Neoclassical economists specify geographic discontinuities in wage rates as the driving force behind both internal and international migration, whereas those subscribing to the new economics of labor migration attribute it to failures in local markets for capital, credit, and insurance (cf. Todaro and Maruszko 1987; Stark 1991). Institutional theorists view migration as a response to structural shifts experienced by societies as they move towards markets and integrate within global regimes of trade and investment, which leads to population displacements that produce both internal and international mobility (cf. North 1981; Sassen 1988). Sociologists have emphasized the embeddedness of decision-makers within social organizations (Portes and Sensenbrenner 1993), notably migrant networks that yield social capital to facilitate movement (Massey 1990). Anthropologists, as well as sociologists, have sought to incorporate culture into the analysis (Kearney 1986), the former by considering the subjective meanings of migration to individuals and groups (Rouse 1991, 1992) and the latter by hypothesizing a “culture of migration” that contributes to the

cumulative causation of migration over time, most notably in the case of international migration (Kandel and Massey 2002).

In none of these disciplinary accounts do environmental conditions figure as salient determinants of migrant decision-making. To the extent that environmental conditions are mentioned, they are either assumed to be a consequence of market expansion (e.g., the consolidation of landholding and the mechanization of production—see Massey et al. 1998) or they are addressed under the rubric of "population pressure" (whereby demographic growth increases demands on natural resources to cause environmental deterioration—see Massey and Taylor 2004). Moreover, despite historical evidence indicating a lagged correlation between population growth and emigration (see Thomas 1973; Hatton and Williamson 1998), contemporary social scientists generally downplay "population pressure" as a fundamental cause of migration (Massey et al 1998), noting that rates of natural increase are uncorrelated with rates of international out-migration around the world today (Zlotnick 2004)

Despite the lack of credence given to environmental factors among social scientists, there is a growing body of evidence that both the gradual deterioration of local environments (through deforestation, aridity, desertification, and loss of biodiversity) as well as natural calamities and disasters (earthquakes, tsunamis, hurricanes, and typhoons) are fundamentally related to out-migration (Adamo and Crews_Meyer 2006; Ezra 2000; Findley 1994; Hermsmeyer 2005; Henry, Schoumaker and Beauchemin 2004). The term "environmental refugees" was first introduced by Lester Brown (1970) and later defined by El-Hinnawi (1985) to describe people displaced through natural disasters or gradual environmental degradation. Based on his review of global conditions, Jacobsen (1988) estimated the number of environmental refugees to be 10 million in the mid-1980s, a figure that Myers (1997) put at 25 million by the mid-1990s. More recent estimates are even gloomier, suggesting a rapid increase to numbers closer to 50 million by the end of year 2010 and 150 million by the end of 2050 (Mayer 1993Mayer 2002; UNU 2007).

The concept of environmental refugees has been criticized for its vagueness and lack of specificity and such numbers are often derided as inflated (see Black 1998, 2001), and Bates (2002) suggests "environmental emigrant" as an alternative. Nonetheless, the concept remains popular among environmentalists, ecologists, development activists, and some scholars (Suhrke 1994). Indeed, recent studies suggest that that gradual changes in environmental conditions because of rising sea levels, drought, siltation, salinization, deforestation, and desertification often impair the ability of people to earn livelihoods, forcing them to leave places of origin and become environmental refugees (Myers and Kent 1995; Henery, Schoumaker and Beauchemin 2004; Adamo and Crews-Meyer 2006). As Adamo (2009) has pointed out, "frequently environmental 'push' factors are intertwined with economic issues." We therefore conceptualize environmental refugees to include people who are forced to move to secure their livelihood because of hardship stemming from environmental changes.

One reason for the lack of consensus about environmental effects on migration is the scarcity of good data on the subject. In his review of the evidence, Castles (2002) points out that whereas Myers and Kent (1995) list millions of people *at risk* of environmental displacement, they do not offer counts of people who *actually moved* for environmental reasons. Nonetheless, specific case studies do appear to link population growth, environmental deterioration, and political violence to migration (see Henery, Schoumaker and Beauchemin 2004; Homer-Dixon 1991, 1994), a combination of forces that Lee (2001) calls the "environment-security nexus." However, these studies also show that environmental conditions are but one factor in a complex of causally interconnected

variables whose mutual influence cannot be sorted out in qualitative accounts (see Adamo and Crews_Meyer 2006; Castles 2002; Wood 2001).

In this analysis we seek to assess the causal importance of environmental deterioration on human migration by taking advantage of prospective longitudinal data gathered in Nepal's Chitwan Valley during the late 1990s. These data allow us to assess the influence of environmental conditions at baseline—actual and perceived---on the likelihood of out-migration during the ensuing 36 months while controlling for social and economic factors currently favored by social scientists in explaining population mobility. This analysis not only permits us to assess the significance of environmental conditions in determining human migration, but also to measure the relative importance of environmental degradation versus other factors in migrant decision-making.

Migration in Nepal

Nepalese society consists of more than 60 ethnic/caste and linguistic subgroups (Bista, 1972; Dahal 1993; Panta 1995) that have formed historically through successive waves of migration from India in the South and Tibet in the North. Although the ethnic composition of Nepal suggests considerable immigration early in the country's history, population mobility remained at a virtual standstill for more than a century, both internally and internationally. This situation changed in the 1950s, when rapid population growth in the hill and mountain regions of the country brought about food shortages that caused less productive land to be put into production, leading to deforestation and the extension of farming to steeper slopes, thereby threatening the stability of fragile mountain ecosystems (Blaikie, Cameron, & Sedon 1980; Eckholm 1976; Macfarlane 1976; Rana 1998). At the same time, Nepal also experienced devastating natural calamities such as flooding and landslides that brought about a great loss of life and resources throughout the country. In response, the government adopted a population redistribution strategy that designated forested valleys in the Terai region for clearing and settlement (Joshi 1995).

The natural disasters combined with the resettlement program led to a burst of internal migration from the hill country to the Terai region that is still continuing today (Chauhan, 1971; Gurung 1980). The Chitwan Valley, our study site, was one of those areas in the Terai that was opened as a new settlement region, and the first arrivals in the 1960s and 1970s were likely themselves environmental refugees fleeing floods and landslides in the hills. In the next section we discuss how these settlers and their descendants may have become second generation environmental refugees through the gradual degradation of the valley's ecosystem.

Nepal's environment is as varied as its population, with one of the world's most diverse ecologies but also one of its most delicate (Chaudhary 1998; Shrestha 1993). The Himalayan environment is presently suffering from rapid deforestation and soil erosion, which threaten native flora and fauna and undermine local biodiversity to put many regions on the brink of serious environmental degradation (Blaike, Cameron, and Seddon 1980; Blaike and Brookfield 1987; Eckholm 1976; Ives and Messerli 1989). Our study area is the Western Chitwan Valley of South-Central Nepal, a wide, flat valley nestled in the Himalayan foothills approximately 450 feet above sea level. Until the early 1950s, Chitwan was covered by virgin forests, infested with malaria-carrying mosquitoes, and home to many dangerous fauna, ranging from poisonous snakes to Bengal Tigers. Beginning in the mid-1950s the Nepalese government began a program to clear the forest, eradicate malaria, and distribute cleared land to settlers from the highlands. As can be seen in the map shown in Figure 1, approximately one-third of the original forest was preserved as Chitwan National Park, which remains home to several endangered species today.

Rich soils, flat terrain, and the promise of new opportunities drew highland farmers into the valley, but it remained a remote and isolated frontier until 1979, when the first all-weather road was completed (see Shrestha et al. 1993). This road linked Chitwan's largest town, Narayanghat, to the eastern portion of Nepal's East-West highway and, therefore, to cities throughout Eastern Nepal and India. Two other important roads quickly followed: one to the west that linked Narayanghat to the western portion of Nepal's East-West highway and the other to the north that connected Narayanghat to Kathmandu, Nepal's capital.

Because of Narayanghat's central location, by the mid-1980s this once isolated town had become a major transportation hub for the entire country. This change was accompanied by a proliferation of government services, business expansion, and growing employment (Pokharel and Shivakoti 1986; Axinn and Yabiku 2001). The government invested heavily in agriculture, with large outlays for irrigation, mechanization, improved seeds, pesticides, fertilizer, and new methods of production and marketing (Shivakoti and Pokharel 1989). Bus service made Narayangha's jobs and business opportunities accessible throughout the valley and commercial enterprises such as grain mills and retail outlets, as well as government services such as schools, health clinics, post offices, and police stations—sprang up everywhere. The valley's population grew rapidly through both in-migration and natural increase and today about 75% of residents were born in Chitwan and the rest elsewhere (His Majesty's Government of Nepal 1987; Shrestha et al. 1993; Tuladhar 1989).

Within the lifetimes of most residents, therefore, the social and economic structure of Chitwan has been radically transformed, and these shifts brought were associated with rapid changes in environmental conditions. Whereas in the 1970s Chitwan was relatively homogeneous in terms of access to natural resources, by the late 1990s the proliferation of private and governmental organizations had shifted land use away from forestry and agriculture toward buildings and physical infrastructure (Axinn and Ghimire 2007; Shivakoti et al 1999). These changes greatly increased variation in access to firewood and fodder, which most families use on a daily basis (Axinn and Axinn 1983; Biddlecom et al. 2005). The macro-level proliferation of non-family organizations was accompanied by significant micro-level changes in environmental quality, such that many farmers came to see natural resources as deteriorating (Barber et al. 2003). Taken together, real declines in access to firewood and fodder, a growing scarcity of agricultural land, increases in population density, and the spreading perception that farmland was declining in productivity seem likely to motivate out-migration from Chitwan, independently of whatever social and economic mechanisms are also in play.

Declining access to firewood, for example, generally requires the use of a substitute fuel, such as kerosene, gas, or electricity, which must be purchased on local markets. Research shows there is indeed a significant fuel transition underway in Chitwan that is closely related to such alternative energy sources and to goods that use them (such as heaters and stoves) (Link, Axinn, and Ghimire 2010). To the extent that environmental degradation reduces access to firewood and brings about a shift to fuels distributed through markets, therefore, it can be expected to motivate migration as a means to earn the money required for the purchase of these alternative fuels and the products that use them. Although the government's Parks and People Program has worked to establish managed community forests along the national park boundary, these are accessible only to a tiny fraction of the study population.

Likewise, declining access to fodder either requires households to shift away from animal husbandry as a source of income to purchase commercial feeds on local markets in order to sustain their livestock, which again create a demand for income and a motivation for labor migration. Similarly, rising population density, which has grown by a factor of five since

Chitwan opened for settlement (Ghimire and Axinn 2006), can generally be expected to put greater pressure on agrarian resources, to which households may respond by increasing agricultural production. The latter may be accomplished through irrigation, greater use of fertilizers, and the deployment of improved seeds. These investments require money, however, thus creating a potential motivation for labor migration as a means of financing them.

Production may also be expanded by increasing the amount of land under cultivation or by multiplying the number of harvests per year and Chitwan was indeed the site of tremendous agricultural extension during the 1950s and 1960s, and substantial agricultural intensification in the 1970s and 1980s. Intensification included irrigation, fertilizer, mechanization, improved seeds, and the creation of the country's first agricultural institute (located in Chitwan). But by the 1990s this intensification was largely over and from 1996–2000 there was negligible change or variation in intensification. At this point, virtually all arable land is now in use and opportunities for multi-cropping are constrained by the seasonality of rainfall. Virtually all farming in the valley is rain fed, and no significant irrigation projects were initiated either publicly or privately during the study period. Since rain only falls during the summer months, the possibilities for adding additional crop rotations are thus quite limited.

Dimensions of Environmental Variation and Migration in Chitwan

In sum, with its combination of rapid population growth, accelerating social change, ongoing economic development, and quickly changing ecology, Nepal's Chitwan Valley offers an ideal setting to test the relative influence of environmental conditions on migration. A key issue in studying how environmental trends influence demographic behavior is specifying which aspects of environmental change are most relevant. Previous research has considered an extremely broad set of environmental conditions, including deforestation, flooding, and drought; aridity, desertification, and salinization; air, water and soil pollution; land use and land cover; overuse of fertilizers, pesticides, and irrigation; overpopulation and land fragmentation; and perceptions of change with respect to land productivity and access to natural resources (Bhandari 2004; Bilsborrow 1992; Bilsborrow and DeLargy 1991; Blaike and Brookfield 1987; Bongaarts 1996; Boserup 1965–[1981]; Cohen 1995; Ehrlich, Ehrlich and Daily 1993; Foster and Rosenzweig 2003, [2004]; Heilig 1997; Hill 1990; Hamilton, Seyfrit, and Bellinger 1997; Moran, Brondizio and VanWey 2005; Moran and Brondizio 1998; Perz 1997). From these alternatives we chose five conditions to represent the leading dimensions of environmental change within the Chitwan Valley: population density, perceptions of agricultural productivity, access to locally important natural resources, and land use patterns. For a variety of reasons outlined below we hypothesize that shifts in these conditions have significantly affected migratory behavior within and outside the valley.

First, scholars have long argued that out-migration follows from rising population density, dating back to Davis' theory of multiphasic demographic change (Bilsborrow 1992; Davis 1963). Given any particular social and economic infrastructure, rising density affects the environment by producing greater pollution and more rapid consumption of natural resources, which, in turn, motivate residents to leave (Bhandari 2004; Conway and Shrestha 1981; Dignan 1989; Thomas 1973; Gurung 1999; Hatton and Williamson 1998; Shrestha 1990; Thacker 1991). We thus hypothesize that higher levels of population density will be associated with higher rates of out-migration among residents of the Chitwan Valley.

Second, because Chitwan is almost entirely agricultural, perceptions of land productivity are likely to be particularly powerful in motivating behavior (Ghimire and Mohai 2005; Thacker

1991). Local farmers who believe that land resources in their area have become less productive over time are more likely to search for productive options elsewhere. Farmers in this part of Nepal practice an intensive rotation of three crops per year, with rice being the most important. Land productivity is essential for both subsistence and income generation among local families. We therefore predict that a perceived decline in agricultural productivity will be associated with a greater likelihood of out-migration among farm households.

Third, the direction of land use change in this setting is away from open farmland towards more developed, built environments, with potentially serious consequences for farmers (Axinn and Ghimire 2002; Shivakoti et al. 1999). As agricultural land becomes scarcer, families must either move to find additional land or leave the agricultural sector entirely to pursue other occupations. The search for new land clearly promotes migration; but the migration literature also indicates that moves out of agriculture into other sectors likewise entail geographic mobility. We thus predict that local areas with less land available for extension will have higher rates of out-migration than those where agriculture is more abundant.

Fourth, in this agrarian setting access to fodder for animals is a critical resource. The husbandry of large and small animals is a key component of food production in the valley, and virtually every family cares for at least some animals; and among larger farms livestock cultivation is extensive (Axinn and Axinn 1983; Fox 1987; Ghimire and Mohai 2005). In addition to grazing land, herds require fodder to be collected from local forests that have steadily been reduced owing to deforestation. Because declining access to fodder implies more work and time to gather it, farm families facing a local scarcity of fodder are motivated to relocate to areas closer to forests and vegetation. We thus predict that families facing less access to fodder will evince higher rates of out-migration.

Fifth, even more than fodder, nearly all households rely on firewood for heating and cooking, and it also must be collected from local forests that are steadily declining (Biddlecom, Axinn and Barber 2005; Filmer and Pritchett 1997; Kumar and Hotchkiss 1988; Schmidt-Vogt 1994; Seddon 1989; Shrestha 1999). As with fodder, therefore, less access to firewood is hypothesized to motivate migration to areas with more abundant forests. In this part of Nepal, however, the collection of fodder and firewood are highly gendered activities, with women primarily responsible for gathering fodder and men more likely to collect firewood (Bhandari 2004; Kumar and Hotchkiss 1988). Because of this important gender differentiation, variations in access to fodder and firewood are expected to have different effects on the migratory behavior of men and women.

Finally, we differentiate among moves by distance because we expect environmental change to have stronger effects on local than long-distance mobility. Given that the Chitwan Valley continues to exhibit a great deal of environmental variation, we expect local environmental changes to have a stronger influence on moves within the valley than on long-distance moves out of the valley. To the extent that residents are motivated to move by environmental changes, they can usually find improved conditions without leaving the valley. This distinction is important because it underscores a salient reason for why the migration literature has overlooked environmental influences. Whereas most theoretical models and research investigations have focused on long-distance moves, environmental change may primarily influence local geographic mobility, rendering environmental influences invisible in most studies.

Data and Methods

Our analysis draws on data from the Chitwan Valley Family Study (CVFS), which offers a unique resource for studying the effect of environmental change on migration. Not only does the CVFS database offer objective and subjective assessments of environmental conditions, it also allows us to distinguish between local and long-distance moves while controlling for the confounding effects of social and economic variables typically used by social scientists to predict migration. The study gathers four basic kinds of information: household survey data, individual interviews that include detailed life histories, land use data, and data from a monthly registry of demographic events.

These data were collected for a larger project that aimed to understand the reciprocal relations between environment change and population processes. The present study is part of that larger project, focusing on a particular population process that heretofore has been understudied---human mobility. For purposes of sample design, the entire valley was divided into mutually exclusive “neighborhoods”—geographic clusters of 5–15 households—and these were selected on an equal probability basis using a multi-stage cluster design (Barber, Shivakoti, Axinn, and Gajurel 1997). A small cluster size was selected to allow the maximum variation of social and environmental conditions within the valley, an area of roughly 238 square kilometers. The average neighborhood is 0.076 square kilometers. Once a neighborhood was selected, researchers surveyed every household within it, yielding a total of 1,583 households with a 100% response rate at the household level. The baseline survey was completed in 1996 and contained basic measures of household consumption, resources, agricultural practices, and environmental perceptions.

After completing the baseline survey, all individuals aged 15–59 residing in the household were interviewed separately using a standardized questionnaire that included a life history calendar. Also interviewed in this manner were spouses of respondents who lived elsewhere within Nepal or who were outside the age range. A total of 5,271 individuals were interviewed during this stage with a 97% response rate. The standardized interviews yielded information on family background, personal characteristics, daily experiences, community context, and social attitudes. The life history calendar provided retrospective data on residence, marital status, children, contraceptive use, living arrangements, schooling, and work experience (Axinn, Pearce, and Ghimire 1999; Belli 1998; Freedman et al. 1988). Common identifiers allow events from the life history calendar to be linked to data from the baseline questionnaire.

After these surveys were completed, in early 1997, the study undertook a detailed set of land use measurements for each neighborhood and launched a monthly registry of demographic events, including migration, living arrangements, marriage, birth, death, and contraceptive use. The registry tracked all households in the original sample for three years and followed each household member even if they left the study area. We draw on the resulting 36 person-months of data to define a hazard of out-migration, which we predict from each person’s individual, family, and neighborhood circumstances in 1996. Specifically, we consider all those interviewed at the baseline to be at risk of out-migration in the subsequent period and follow them month-by-month, coding the outcome variable as 0 if they did not migrate in that month and 1 if they did. All person-months subsequent to the departure were excluded from consideration.

Measures of Migration

Measures used in the study are defined in Table 1 along with their means and standard deviations. We employ two complimentary definitions of migration. The first defines a move as any departure *from the neighborhood* lasting one month or more that did *not*

involve a move out of the Chitwan Valley. The second defines migration as a departure *from the Chitwan Valley* lasting at least a month, including both internal moves within Nepal and international moves outside of the country. The latter definition obviously captures long-distance mobility, whereas the former measures short distance mobility. We selected an interval of one month rather than a year or some other duration because we felt that environmentally-generated moves are likely to be of relative short duration and because a monthly interval on corresponds well with person-month event history format. A month is short enough to capture most instrumental, purposive migration but long enough to exclude short trips for recreation or family events.

In this analysis, we focus on the first migratory trip taken by an individual exclude moves undertaken for purposes of marriage or education. As shown in the table, around 12% of all respondents reported moving within the valley during the observation period whereas 29% left the valley. For simplicity, we refer to the former as local moves and the latter as distant moves. Given that migration is defined from the prospective monthly event history, these figures include all non-marital and non-educational moves from each household, except in the small share of cases (2%) where the entire household left the neighborhood in the 32 months following the baseline interview. Since we are focusing on the determinants of first migration, these definitions allow us to operationalize monthly hazards of short and long distance mobility, treating the two kinds of moves as competing, mutually exclusive risks and avoiding potential ambiguities about step migration.

Environmental Measures

We assess local environmental conditions using five basic measures: neighborhood population density, the respondent's perception of changing agricultural productivity, the time required to collect firewood, the time required to gather animal fodder, and the share of neighborhood land covered with flora rather than buildings or infrastructure. We define population density as the number of households per 100,000 square feet[1]. We use households rather than persons because the household serves as the unit of consumption in Nepali society. The average density was around 19 households per 100,000 square feet, but the standard deviation of 64.9 indicates substantial variation across neighborhoods in the sample. We realize, of course, the population density is not a measure of environmental quality per se, but we include it to provide a comparative perspective as many previous studies have used it in that sense.

To assess agricultural productivity, the baseline questionnaire asked: "Compared to three years ago, do you think crop production has increased, decreased or stayed about the same?" Preliminary analyses showed that perceptions of decline had the greatest predictive power so we coded our measure of agricultural productivity as 1 if crop production was perceived to have decreased and 0 otherwise. The growing pressure on Chitwan's land base is indicated by the fact that 57% of respondents perceived that agricultural productivity was declining. We found that people have a strong sense about changes in things that affect their lives, even over just a three-year period.

The survey also asked respondents how long it took them to travel to where fodder or firewood was located, collect it, and then bring it home. Some 83% of households in our sample are involved in subsistence farming and thus generate needed inputs on their own rather than relying on markets. We coded the responses in minutes and for convenience in

[1]Land area comes from the 1996 land use survey, in which a team of field workers mapped the area of each neighborhood using compasses and tape measures. These measurements were digitized and used to calculate the exact area of each neighborhood broken down by category of land use. Neighborhoods ranged in size from 46,762 square feet to 3,223,438 square feet, with a mean of 837,850.

presenting coefficients divided the total by 100. On average respondents reported spending 342 minutes per trip (5.7 hours) collecting firewood and 110 minutes per trip (1.8 hours) to gather fodder. Because distance to forest varies by the location of the neighborhood, a daylong trip is quite common to gather a load of fodder or firewood and walk back to home in our study setting,

We also physically determined the share of each neighborhood that was covered with flora. Although most studies of land use and land cover rely on data derived from remote sensing devices (Liverman et al. 1998; Fox et al. 2003), our detailed on-the-ground measures yield highly accurate and reliable information. On average, around 74% of neighborhood ground area was covered with flora, although again there was substantial variability throughout the valley (see the standard deviation of 22.7).

Control Variables

Our interest here is in measuring the *independent* effects of environmental changes on out-migration while holding constant the effects of social and economic variables that are more typically included in migration models. Although environmental conditions may act indirectly through social and economic channels to influence migration, here we are interested in gauging the strength of the direct relationships and thus hold constant the influence of variables that fall under one of three categories that prior research and theory suggest are critical determinants of migration: human capital, social capital, and physical capital (see Massey et al. 1998). Given that the likelihood of migration also varies in characteristic ways by age and gender, controls for these variables are also included, along with indicators of ethnicity.

Human capital refers to skills, experiences, and abilities that raise an individual's productivity in the labor force, making it more valuable for him or her to migrate (Sjaastad 1962). Measures of human capital were derived from responses to a series of questions on the life history calendar. To measure education, respondents were asked: "Did you ever go to school to study even for one day?" If the answer was "yes" the interviewer then asked: "In which year did you first go to school?" Every year the respondent was in school was recorded on the life history calendar. These questions yield a dichotomous indicator of enrollment in 1996 and the total number of years of schooling prior to that date. Around 16% of respondents were enrolled in school and average education stood at 5.97 years.

Respondents were also asked a series of questions about their work history. This history included measures of both salaried employment and daily wage work and ascertained both the history of work experience and current work status. In rural Nepal, a salaried job implies stable employment, high earnings, social benefits, and certain protections whereas daily wage labor lacks these benefits. We thus developed two different measures of labor force experience---working a salaried job in 1996 and working as a day laborer in 1996, with the former generally denoting a higher status, more abundant skills, and hence potentially greater returns from migration (Sjaastad 1962). Each of these variables is dichotomous, coded 1 if the respondent fell into the category and 0 otherwise. As can be seen, 35% of respondents held a wage job at the time of the baseline survey and 10% had a salaried job.

Social capital refers to the instrumental value that people derive from their social connections to others. In the case of migration, being related to others with prior migratory experience greatly increases the odds of out-migration by reducing the costs and risks of undertaking a trip. We measure social capital in two ways: by the presence of others with migratory experience in the household, and by the relative number of persons within the neighborhood who have migrated in the past, which following Massey et al (1994) we call the migration prevalence ratio. Through their connections to other migrants within the

household and the neighborhood, individuals may be able to tap into valuable knowledge and assistance to facilitate a move.

Our measure of household members' migration experiences comes from individual interviews of those aged 15–59 in 1996, which provided a complete record of all moves. To measure social capital at the household level, we coded a household network tie as 1 if any member of the household had ever moved out of the current neighborhood before 1996 and 0 otherwise. To measure social capital at the neighborhood level, we used the same data to determine the relative number of residents with prior migratory experience in 1996. From the individual life history calendar, we coded migration experience as 1 if an individual had ever moved out from the sample neighborhood before 1996 and 0 otherwise and then computed the proportion of individuals for each neighborhood who ever migrated before 1996.

Because our models analyze both local and distant moves, we constructed the social capital measures to match the specific kind of migration being predicted. In predicting local moves we measured household and neighborhood experience with respect to local moves, whereas in predicting distant moves we measured household and neighborhood experience with respect to moves outside the valley. Among respondents in Chitwan Valley, 23% had a tie to someone who had migrated locally and the average person lived in a neighborhood where 8% of the residents had local migration experience. Likewise, 42% had a tie to someone who had migrated outside the valley and the average person lived in a neighborhood where 16% of residents had undertaken a distant move.

Physical capital refers to the presence or absence of tangible assets within the household or neighborhood. On the one hand, ownership of an asset may encourage migration either by providing collateral for borrowing to finance a trip or by providing a particular motivation for migration, or both. For example, land ownership may motivate a household member to migrate in order to self-finance productive agricultural investments in the absence of viable capital markets, while simultaneously providing the collateral to act on this motivation. On the other hand, the lack of an asset may also signal an important motivation for migration (though not, of course, providing any collateral to finance it, which is where social capital comes in). Throughout the world, one of the most powerful motivations for migration is self-financing the construction or improvement of a home in the absence of effective mortgage and consumer credit markets (Taylor et al. 1996). Thus the lack of an owned home, or the possession of a home of marginal quality, generally increases the odds of out-migration.

Our measures of physical capital come from the baseline interview, which asked a series of question about different types of property ownership, including whether the household owned any agricultural land, whether it owned the house plot, the number of farm animals it owned, and the number of pieces of farm and household equipment it possessed. For the first two variables we developed dichotomous indicators, coded 1 if the household owned farmland or the house plot and 0 otherwise. These two pieces of property are rather widely owned. Some 82% of respondents reported owning the plot upon which their house stood and 87% said they owned farmland.

Our count of livestock owned takes into account the numbers of buffalo, cattle, sheep, goats, and pigs owned by the household. The number of each kind of livestock was converted into a standard "livestock unit" using a conversion factor and these standard units were then summed to create a comparable count of total livestock owned. The average household owned around 2.6 units of standardized livestock. The number of pieces of equipment was determined from questions that asked whether the household owned a radio, television,

bicycle, motorbike, tractor, cart, pumpset, or gober (animal dung) gas plant. For each item present in the household, the index of household goods increased by 1, yielding an index that ranged from 0 to 8. The average on this indicator was 1.8 pieces of equipment. In general, we observe little colinearity between between the ownership of various assets, with the highest correlation coefficient being just 0.27.

We measured housing quality from interviewer observations concerning four attributes of the dwelling: number of stories, material used to make the walls, material used to make the roof, and material used to make the floor. Number of stories is coded from 1 to 5 corresponding to the number of floors in the house. Material used to make the walls is coded from 1 to 6 (concrete = 6, brick = 5, stone = 4, wood = 3, mud = 2, and cane with mud = 1). Material used to make the roof is coded from 1 to 4 (concrete = 4, tin = 3, slate = 2, and thatch = 1). Material used to make the floor is coded from 1 to 4 (concrete = 4, brick = 3, wood = 2, and mud = 1). Overall, the housing quality scale is constructed by summing these four measures, yielding a measure that ranged from 4 to 18 with an average of around 9.2. We use this coding system for two reasons first, because walls, floors, and roofs, built out of concrete is have high economic value. Second, concrete lasts longer than the other materials and has less of an effect on the environment compared, for example, with brick making which requires significant wood burning, and stone and mud collection which accelerate soil erosion. Stone and mud and also need frequent maintenance than bricks or concrete.

Finally, we included an indicator of market access as an indicator of resources accessible to each household. This variable was measured as the number of minutes required to reach the nearest market on foot, where a market is defined by the presence of two or more shops. This variable was highly skewed and in order to improve fit, we took the natural log of the number of minutes, yielding a mean value of 1.87 (around 6.5 minutes).

Demographic controls were measured in straightforward fashion by specifying dummy variables for age and gender, with 55% of our sample being female. We control for age using dummy variables for birth cohorts. In addition, previous research in Chitwan has found that ethnicity exerts a strong effects on fertility intentions (Pearce 2000) and family formation (Axinn & Barber 2001; Ghimire et al. 2006; Thapa 1989, 1997; Yabiku 2006) and we have a priori reason to believe that the same is true for migration. Ethnicity is strongly related to the consumption of environmental resources in Nepal (Axinn, Barber and Biddlecom 2010), consistent with research in other settings that also links ethnicity and cultural differences to consumption patterns (Lutzenhiser 1993; Lutzenhiser, Harris, and Olsen 2001).

Ethnicity in Nepal is complex, multi-faceted, and interrelated with religion, with more than 60 different linguistic subgroups (Bista 1972; Caplan 2000; Dahal 1993; Gurung 1980, 1998; Niraula 1994). A full description of the ethnic groups residing in this setting is beyond the scope of this paper (for detailed descriptions of these groups, see Fricke 1986; Gellner and Quigley 1995; Gurung 1980; Guneratne 1994), but here we investigate five classifications of ethnicity (see Blaikie et al. 1980): 1) high caste Hindus; 2) lower caste Hindus; 3) Newars; 4) hill Tibeto-Burmese (Tamang, Gurung, and Magar); and 5) terai Tibeto-Burmese (Tharu, Derai and Kumal). In Nepal, the relationship of high caste Hindus to the natural resources around them is very different than that of other ethnic groups. Following Axinn and Yabiku (2001), we indicate these categories using dummy variables and take high caste Hindus as the reference category.

Analytic Strategy

The Chitwan Valley Family Study thus offers a promising opportunity to measure the effects of environmental conditions on out-migration while simultaneously controlling for other

social and economic factors known to influence mobility. We use discrete time event history methods to model the monthly hazard of out-migration by particular individuals, with person-months serving as the unit of analysis (Allison 1982, 1984; Petersen 1986, 1991). In doing so, we follow the approach first developed by Massey and Espinosa (1997), who modeled migration between Mexico and the United States using a discrete time model estimated across person years that likewise included both individual and contextual variables. This same strategy has been used successfully in previous studies using the same data (Axinn & Barber, 2001; Axinn & Yabiku, 2001; Brauner-Otto, Axinn and Ghimire 2007; Ghimire, Axinn, Yabiku and Thornton 2006; Yabiku, 2004) including several recently published analyses of migration behavior (Massey, Williams, Axinn and Ghimire 2010; Williams 2009).

We follow individuals within each household month-by-month for 36 months beginning in February 1997 and each month regress the 0–1 migration outcome on independent variables defined as of the 1996 baseline. All person-months subsequent to the one in which a first trip was taken are excluded. As already, noted, local moves within the Chitwan Valley and long-distance moves out of the valley are modeled as competing risks. As a result, in the analyses of local moves individuals are treated as right censored if they make a long-distance move before moving locally and in the analyses of long-distance moves individuals are treated as right censored if they make a local move before leaving the valley. There is no left censoring from the population of interest---residents of the Chitwan Valley in 1996.

We control for duration by counting the number of months transpired since February 1997, along with a squared term, and then estimate the model using the GLIMMIX macro of SAS, following an estimation strategy advocated by Barber et al. (2000). This strategy produces a multilevel hazard model that accounts for the clustering of individuals in our sample by community (see Barber et al. 2000; Yabiku 2004). Although, there is always some chance of more than one individual being away from the same household at the same time, it is very rare in our study setting. Thus, we do not believe that clustering at household level likely to produce biases in our results. Plus, the two level models- individual and neighborhood level- has been estimated successfully in previous studies using the same data set (Axinn & Barber, 2001; Axinn & Yabiku, 2001; Yabiku, 2005).

Environmental Change and Local Mobility

Table 2 presents the results of two separately estimated models, which are functionally equivalent to what is achieved using a single multinomial logit model. The left-hand columns show odds ratios and t-tests for a model estimating the effect of independent variables on the relative likelihood of *leaving the neighborhood* for a period of at least one month and are labeled “local moves.” The top panel shows estimated effects for the five environmental indicators, which are measured in 1996 and are used to predict the odds of initial out-migration during the ensuing 36 months. The middle panels contain various theoretical controls defined according to the kind of capital they represent, and the bottom panels hold constant the effects of demographic factors such as gender, age, ethnicity, and duration.

Among the five environmental indicators we consider, three are significant in predicting local mobility and have effects in the expected direction. Individuals who perceived agricultural productivity to be declining in 1996 were 31% more likely to move within Chitwan during subsequent months than those who did not perceive a decline. In addition, each percentage point increase in the share of the neighborhood that was covered in flora decreased the odds of local mobility by 2% whereas each hundred minute increase in the time to gather firewood increased the odds of moving within Chitwan by 10%. Thus

environmental deterioration as indicated by falling agricultural productivity, declining green space, and decreasing access to firewood indeed serve to increase the odds of undertaking a local move.

The control variables generally behave as one might expect, with the odds of migration declining with age and being lower for females and for those enrolled in school at the beginning of the observation, but higher for those holding salaried occupations, which presumably indicates greater skill and hence greater potential returns to human capital from migration. Home ownership, higher home quality, and greater livestock ownership generally decrease the odds of movement by eliminating home acquisition or improvement as potential motivations for labor migration. Greater access to equipment, however, increases the odds of movement, presumably reflecting a greater need for investment funds owing to a more capital intensive production strategy.

Environmental Effects on Distant Mobility

The right-hand columns of Table 2 show odds ratios and t-tests for the same set of independent variables, but predicting the odds of *leaving the Chitwan Valley* for one month or more (“distant moves”). In general, environmental conditions appear to be more closely tied to local than to long-distance mobility, as only two of the five environmental indicators are significant in predicting the odds of a move outside of the Chitwan Valley. As with local mobility, the perception of a decline in agricultural productivity in 1996 is associated with a higher likelihood of leaving Chitwan, but the effect size is half as large. Neither the extent of green space nor the time required to gather firewood is significantly related to the odds of migrating away from Chitwan. However, less access to fodder is associated with a higher likelihood of undertaking such a move. For each additional 100 minutes in the time required to gather fodder, the odds of leaving Chitwan increase by 9%.

Among control variables, females and persons enrolled in school again display a lower likelihood of migration and the odds of long-distance mobility decline sharply with age. With respect to distant moves, however, human and social capital are more critical as predictors than physical capital. Only ownership of farmland has an effect on the odds of migration, sharply reducing the odds of leaving Chitwan. In contrast, each additional year of schooling increases the odds of a distant move by 6% and those with greater occupational skill (salaried workers) are 42% more likely to leave the valley. Likewise, having someone in the household with migratory experience increases the odds of out-migration by 44% and each percentage point increase in the share of migrants living in a person’s neighborhood raises the odds of leaving Chitwan by a remarkable factor of 3.75. Other things equal, Hill-Tibeto Burmese people are 26% more likely than others to leave the valley. This group, of course, consists of lower-status in-migrants who originally settled the valley in the 1960s and 1970s and their descendents.

Gender, Environment, and Mobility

The foregoing results suggest that environmental conditions are strongly linked to local mobility but more weakly connected to long-distance moves. It may be, however, that the influence of environmental variables varies by gender given the gender-specific nature of the tasks of gathering firewood versus fodder. As firewood is heavier than fodder, and given the fact that men display greater upper-body strength than women, collecting the former is generally considered a “male” task whereas gathering the latter is culturally defined as “female.” Given this gendered division of labor, we might expect the time spent to gather firewood to affect the mobility of men but not women, and the time to gather fodder to influence women but not men, and this is generally what our analyses reveal.

Table 3 contrasts the effect of environmental variables on the odds that men and women undertake local and distant moves. For the sake of parsimony t-tests are not reported and statistical significance is simply indicated by asterisks, but owing to the reduction in degrees of freedom achieved by subdividing the sample, in this table we relax the criterion for statistical significance and also show effects at the 10% level. As expected, every extra hundred minutes required to gather firewood increases the odds of local migration among males by 16% but has no significant effect on the likelihood of female mobility within Chitwan. Likewise, every 100 additional minutes required to collect fodder increases the odds local mobility by 21% for females, but has no influence on the odds of male mobility within the valley. Consistent with this effect, increasing green space reduces the odds of local mobility by females but not males. Each percentage point increase in green space reduces the odds of female migration within Chitwan by around 3%

With respect to distant migration, we observe a similar gender contrast. Whereas each additional 100 minutes of time required to collect fodder increases the odds of leaving Chitwan by 14% for females it has no effect on the mobility of males. A perceived decline in agricultural productivity increases the odds of local mobility among both men and women, but only has a significant effect on distant moves among males. As before, the effect of environmental conditions generally appears to be greater on local than distant moves.

Environment, Mobility, and Ethnicity

Patterns of consumption exhibited by high caste Hindus offer a contrast in the use of grazing land and other environmental resources. On the one hand, high caste Hindus are more likely to own cows and buffaloes than other groups, and thus much less likely to buy their milk (Axinn, Barber and Biddlecom 2010). As a result, high caste Hindus depend more on grazing resources nearby their homes to care for their animals. On the other hand, high caste Hindus are significantly less likely to use common land grazing resources, more likely to buy fuel rather than gather it, and more likely buy consumer durables whatever their incomes and assets (Axinn, Barber and Biddlecom 2010). Combined with their relatively advantaged economic position, this makes high caste Hindus much less likely to respond to local environmental circumstances than other ethnic groups.

In order to explore the influence of ethnicity further, in Table 4 we estimated models separately for high caste Hindus and all others, seeking to learn whether environmental conditions have differential effects on local mobility by ethnicity. As can be seen, environmental factors do not appear to affect significantly the migratory behavior of high caste Hindus, the privileged group in the local ethnic hierarchy. Their mobility is more determined by human capital, social capital, and demographic factors. None of the environmental indices significantly affects the odds that a high caste Hindu undertakes a local move, whereas three of the five measures are significant in predicting local moves by other castes. As expected, a perceived decline in agricultural productivity raised the odds of a local move by 48% among people who are not high caste Hindus, whereas each percentage point increase in green space reduces the odds of migration by 3% and every additional 100 minutes in time required to gather firewood raises the odds of local movement by 17%.

In terms of distant moves, only one environmental factor---the time required to collect fodder---significantly influences the odds of long-distance migration among high caste Hindus. Thus environmental deterioration appears to affect this group only because they are more likely to own cows and less likely to rely on communal lands, which pushes them toward long-distance migration as a means of earning money for the purchase of commercial feeds. Among lower status Hindus and other ethnic groups, in contrast, a perceived decline

in agricultural productivity is strongly related to long-distance migration in addition to rising time to collect fodder. Whereas a perceived decline in productivity raised the odds by non-elite Nepalese by 29%, each additional 100 minutes of time required to gather fodder increased the odds by 12%, compared with figures of 6% and 15% among the Hindu elite. In general, within the Chiwan Valley environmental effects on mobility appear to be concentrated primarily among the less privileged categories of Nepal's ethnic hierarchy.

Conclusion

In this study we employed a unique data set available from the Chitwan Valley Family Study to measure the effects of environmental conditions of migration while holding constant the effects of human, social, and physical capital and controlling for demographic factors such as age, gender, ethnicity, and duration. We estimated discrete time hazard models to predict the odds of out-migration during the 36 person-months following February 1997 given individual, household, and environmental characteristics observed in 1996 and using two different definitions of migration: within and outside the Chitwan Valley.

We found no evidence that migration—either local or distant—was related to demographic pressure as measured by population density. Neighborhood density had no significant influence on the likelihood either of moving away from the neighborhood or out of the valley. Perceived agrarian productivity, the share of the neighborhood covered in flora, and the time required to collect firewood did influence mobility, but these factors mainly promoted local rather than distant moves. As agricultural productivity declines and the share of the neighborhood covered in flora falls, and as the time to collect firewood correspondingly increases, individuals are more likely to leave their home neighborhood to look for opportunities elsewhere in the vicinity.

Although the odds of leaving the Chitwan Valley are significantly increased by perceived decline in agricultural productivity, the effect was much smaller than that observed for local moves and it was only significant among lower and non-Hindu castes. This single environmental effect, meanwhile, occurred in the context of much more powerful social and economic influences on migratory behavior. The environment, therefore, is just one of a set of factors that influence long-distance mobility and it is by no means the most important. Both social capital and human capital have much stronger and more consistent effects on migration out of Chitwan.

In general, our findings are consistent with the argument that the deeper underlying causes of environmental migration are not only related to the severe environmental calamities, but also to a more gradual deterioration of conditions and to subjective perceptions about the degree of deterioration ((Adimo and Crews_Meyer 2006; Henry et al. 2003, 2004). Moreover, although environmental factors affect everyone, the response of individuals varies greatly by their socioeconomic conditions, and as Adamo (2009) has indicated, environmental factors are generally intertwined with socio-economic and demographic processes in determining the likelihood of movement.

The environmental effects that we detected on local population mobility appear to vary between men and women in a way that is consistent with the gendered division of labor in Nepal. Thus the time required to collect firewood—a stereotypically male task in Chitwan—affects the odds of male but not female mobility within the valley, whereas the time required to gather fodder, which is generally considered a female task, affects the odds of female but not male migration outside of the valley. Female migration within Chitwan is also related to perceived decline in agricultural productivity, but the effect of falling agricultural productivity on local and distant moves was confined to lower-caste Hindu and non-Hindu

groups. The influence on local mobility of land cover and time to gather firewood was likewise confined to these groups, suggesting that caste privilege may insulate people from the negative economic effects of environmental deterioration.

In general, these results cast doubt on the broader validity of the concept of "environmental refugees" with respect to long distance migration. We find little evidence that rising population density, declining vegetation, or a growing scarcity of organic inputs play any role in promoting departures from the Chitwan Valley, and the long-distance mobility provoked by declining agricultural productivity is relatively weak and is confined to *perceptions* of declining mobility among low caste Hindu and non-Hindu ethnic groups. As formulated by El-Hinnawi (1985), Jacobsen (1988), Myers (1997), and others, the concept of "environmental refugees" was introduced to frame environmental change as a major driver of migration worldwide, but our findings suggest that gradual environmental deterioration that we observed in Chitwan does not produce mass migration to *distant* locales. Our findings are more consistent with results from Burkina Faso, which indicate that people from drier areas are more likely to move to other rural areas that are either adjoining or a short distance away (Henry et al., 2003, 2004).

Although large numbers of people may be displaced by large-scale natural and human-caused disasters in Africa and Asia, these moves are generally to adjacent areas and end up being classified as international owing more to the legacy of colonialism than anything else. Although more work clearly needs to be done using representative data from other regions, the present analysis suggests that demographers should exercise caution in viewing "environmental refugees" as a major component of migratory streams around the world. For the most part, environmental deterioration appears to promote local searches for organic inputs or alternative employment opportunities, not a desperate search for relief in distant lands.

References

Adamo, SB. IHDP Update 1.2009. Bonn, Germany: International Human Dimensions Programme on Global Environmental Change; 2009. Environmentally induced population displacements.

Adamo SB, Crews-Meyer KA. Aridity and desertification: Exploring environmental hazards in Jàchal, Argentina. Applied Geography 2006;26(1):61–85.

Allison PD. Discrete-time methods for the analysis of event histories. Sociological Methodology 1982;13(1):61–98.

Allison, PD. Event History Analysis: Regression for Longitudinal Event Data. Beverly Hills: Sage Publications; 1984.

Axinn, NW.; Axinn, GH. Small Farms in Nepal: A Farming Systems Approach to Description. Kathmandu, Nepal: Rural Life Associates; 1983.

Axinn WG, Barber JS. Mass education and fertility transition. American Sociological Review 2001;66(4):481–505.

Axinn WG, Barber JS, Biddlecom AE. Social organization and the transition from direct to indirect consumption. Social Science Research 2010;39(3):357–368. [PubMed: 20514347]

Axinn, WG.; Ghimire, DJ. Population and environment: the impact of fertility on land use in an agricultural society. Paper presented at the Annual Meeting of the Population Association of America; May 9–11; Atlanta, GA. 2002.

Axinn WG, Pearce LD, Ghimire DJ. Innovations in life history calendar applications. Social Science Research 1999;28(3):243–264.

Axinn WG, Yabiku ST. Social change, the social organization of families, and fertility limitation. American Journal of Sociology 2001;106(5):1219–1261.

Barber JS, Biddlecom AE, Axinn WG. Neighborhood social change and perceptions of environmental degradation. Population and Environment 2003;25(1):77–108.

Barber JS, Murphy S, Axinn WG, Maples J. Discrete-time multilevel hazard analysis. Sociological Methodology 2000;30(1):201–35.

Barber JS, Shivakoti GP, Axinn WG, Gajurel K. Sampling strategies for rural settings: a detailed example from Chitwan Valley Family Study, Nepal. Nepal Population Journal 1997;6(5):193–203.

Bates DC. Environmental refugees? Classifying human migrations caused by environmental change. Population and Environment 2002;23(5):465–477.

Belli RF. The structure of autobiographical memory and the event history calendar: Potential improvements in the quality of retrospective reports in surveys. Memory 1998;6(4):383–406. [PubMed: 9829098]

Bhandari P. Relative deprivation and migration in an agricultural setting of Nepal. Population and Environment 2004;25(5):475–99.

Biddlecom AE, Axinn WG, Barber JS. Environmental effects on family size preferences and subsequent reproductive behavior in Nepal. Population and Environment 2005;26(3):183–206.

Bilsborrow RE. Population growth, internal migration and environmental degradation in rural areas of developing countries. European Journal of Population 1992;8(2):125–48. [PubMed: 12158965]

Bilsborrow RE, DeLargy PF. Population growth, natural resource use and migration in the third world: the cases of Guatemala and Sudan. Population and Development Review 1991;16(S):125–147.

Bista, DB. People of Nepal. Kathmandu: Ratna Pustak Bhandar; 1972.

Black, R. Refugees, Environment, and Development. London: Longman; 1998.

Black R. Environmental refugees: myth or reality. United Nations High Commissioner for Refugees Working Papers 2001;34:1–19.

Blaikie, P.; Brookffield, H., editors. Land Degradation and Society. New York: Routledge Kegan & Paul; 1987.

Blaike, P.; Cameron, J.; Seddon, D. Nepal in Crisis: Growth and Stagnation at the Periphery. Bombay: Oxford University Press Delhi; 1980.

Bongaarts J. Population pressure and food supply system in the developing world. Population and Development Review 1996;22(3):483–503.

Boserup, E. The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure. Chicago: Aldine Press; 1965.

Boserup, E. Population and Technological Change: A Study of Long-Term Trends. Chicago: University of Chicago Press; 1981.

Brauner-Otto SR, Axinn WG, Ghimire DJ. The spread of health services and fertility transition. Demography 2007;44(4):747–770. [PubMed: 18232209]

Caplan, L. Land and Social Change in East Nepal: A Study of Hindu-Tribal Relations. 2. Kathmandu: Himal Books; 2000.

Castles, S. Environmental Change and Forced Migration: Making Sense of the Debate. Geneva: United Nations High Commissioner for Refugees; 2002.

Chaudhary, RP. Biodiversity in Nepal: Status and Conservation. Saharanpur and Bangkok: S. Devi & Teepress Books; 1998.

Cohen, Jl. How Many People can the Earth Support?. New York: Norton; 1995.

Conway, D.; Shrestha, NR. Causes and Consequences of Rural-to-Rural Migration in Nepal. Bloomington: Indiana University; 1981.

Dahal DR. Rethinking fertility transitions: some observations from Nepal. Population Dynamics in Nepal 1993;2(1):49–58.

Davis K. The theory of change and response in modern demographic history. Population Index 1963;29(4):345–366. [PubMed: 12335951]

Dignan T. Land and landlessness among rural to rural migrants in Nepal's Terai region. International Regional Science Review 1989;12(20):189–209. [PubMed: 12342549]

Eckholm, EP. Losing Ground: Environmental Stress and World Food Prospects. New York: Norton; 1976.

El-Hinnawi, E. Environmental Refugees. Nairobi: United Nations Environment Programme; 1985.

Ehrlich P, Ehrlich A, Daily G. Food security, population, and environment. Population and Development Review 1993;19(1):1–32.

Ezra M. Leaving-home of young adults under condition of ecological stress in the drought prone communities of northen Ethiopia. Genus 2000;56(3–4):121–144.

Filmer, D.; Pritchett, L. World Bank Policy Research Paper Number. Vol. 1623. Washington, D.C: World Bank; 1997. Environment degradation and demand for children: searching for the vicious circle.

Findley S. Does drought increase migration? A study of migration from rural Mali during the 1983–1985 drought. International Migration Review 1994;28(3):539–553. [PubMed: 12345794]

Foster AD, Rosenzweig MR. Economic growth and the rise of the forest. The Quarterly Journal of Economics 2003;118(1):601–37.

Foster AD, Rosenzweig MR. Agricultural productivity growth, rural economic diversity, and economic reforms: India, 1970–2000. Economic Development and Cultural Change 2004;52(3): 509–42.

Fox JM. Livestock ownership patterns in a Nepali village. Mountain Research and Development 1987;7(2):169–172.

Fox, J.; Rindfuss, RR.; Walsh, SJ.; Mishra, V., editors. People and the Environment: Approaches for Linking Household and Community Surveys to Remote Sensing and GIS. Berlin: Kluwer Academic Publishers; 2003.

Freedman D, Thornton A, Camburn D, Alwin D, Young-DeMarco L. The life history calendar: a technique for collecting retrospective data. Sociological Methodology 1988;18(1):37–68. [PubMed: 12282712]

Fricke, T. Himalayan Households: Tamang Demography and Domestic Processes. Ann Arbor: UMI Research Press; 1986.

Gellner, DN.; Quigley, D., editors. Contested Hierarchies: A Collaborative Ethnography of Caste among the Newars of the Kathmandu Valley, Nepal. New York: Oxford University Press; 1995.

Ghimire DJ, Mohai P. Environmentalism and contraceptive use: how people in less developed settings approach environmental issues. Population and Environment 2005;27(1):29–61.

Ghimire DJ, Axinn William G. Family Change in Nepal: Evidence from Western Chitwan. Contributions to Nepalese Studies 2006;33(2):177–201.

Ghimire DJ, Axinn WG, Yabiku ST, Thornton A. Social change, premarital non-family experiences and Spouse Choice in an Arranged Marriage Society. American Journal of Sociology 2006;111(4): 1181–1218.

Guneratne, UA. Unpublished Dissertation. University of Chicago; 1994. The Tharus of Chitwan: Ethnicity, Class and the State in Nepal.

Gurung, GM. Migration, politics and deforestation in lowland Nepal. In: Skar, HO., editor. Nepal: Tharu and Tarai Neighbours. Kathmandu: Educational Enterprises, Mandala Book Point, Ratna Pustak Bhandar; 1999. p. 85-95.

Gurung, HB. Vignettes of Nepal. Kathmandu: Sajha Prakashan; 1980.

Gurung, SB. The land and the people. In: Shumshere, P.; Rana, JB.; Dhungel, DN., editors. Contemporary Nepal. New Delhi: Vikas Publishing House; 1998. p. 1-13.

Hamilton L, Seyfrit C, Bellinger C. Environment and sex ratios among Alaskan Natives: an historical perspective. Population and Environment 1997;18(3):283–299.

Hatton, TG.; Williamson, JG. The Age of Mass Migration: Causes and Economic Impact. Oxford: Oxford University Press; 1998.

Heilig GK. Anthropogenic factors in land-use Change in China. Population and Development Review 1997;23(1):139–68.

Henry S, Boyle P, Lambin EF. Modeling inter-provincial migration in Burkina Faso, West Africa: the role of socio-demographic and environmental factors. Applied Geography 2003;23(1):115–136.

Henry S, Schoumaker B, Beauchemin C. The impact of rainfall on the first out migration: a multi-level event history analysis in Burkina Faso. Population and Environment 2004;25(5):423–460.

Hermsmeyer, HA. Contemporary Topics in Forced Migration Working Papers. Vol. 2. Forced Migration Laboratory, Center for Comparative Immigration Studies, University of California; San Diego: 2005. Environmental refugees: a denial ofrRights; p. 2-19.

Hill, A. Demographic responses to food shortages in the Sahel. In: McNicoll, G.; Cain, M., editors. Rural Development and Population: Institutions and Policy. New York: Oxford University Press; 1990.

His Majesty's Government of Nepal. Population Monograph of Nepal. Kathmandu: National Planning Commission Secretariat; 1987.

Homer-Dixon TF. On the threshold: environmental changes as causes of acute conflict. International Security 1991;16(2):76–116.

Homer-Dixon TF. Across the threshold: empirical evidence on environmental Scarcities as causes of violent conflict. International Security 1994;19(1):5–40.

Ives, JD.; Messerli, B. The Himalayan Dilemma: Reconciling Development and Conservation. New York: Routledge; 1989.

Jacobsen, J. WorldWatch Paper. Vol. 86. World Watch Institute; Washington, D.C: 1988. Environmental refugees: a yardstick of habitability.

Kandel W, Massey DS. The culture of Mexican migration: a theoretical and empirical analysis. Social Forces 2002;80(3):981–1004.

Kearney M. From the invisible hand to visible feet: anthropological studies of migration and development. Annual Review of Anthropology 1986;15(1):331–61.

Kumar, SK.; Hotchkiss, D. International Food Policy Institute Research Report. Vol. 69. Washington, D.C: 1988. Consequences of deforestation for women's time allocation, agricultural production, and nutrition in hill areas of Nepal.

Lee, SW. Environment Matters: Conflict, Refugees, and International Relations. Seoul and Tokyo: World Human Development Institute Press; 2001.

Link, CF.; Axinn, WG.; Ghimire, DJ. Working Paper. Survey Research Center, University of Michigan; 2010. Household energy consumption: community context and the fuelwood transition.

Liverman, D.; Moran, EF.; Rindfuss, RR.; Stern, PC. People and Pixels: Linking Remote Sensing and Social Science. Washington, D.C: National Academy Press; 1998.

Lutzenhiser, Loren. Social and Behavioral Aspects of Energy Use. Annual Review of Energy and the Environment 1993;18(1):247–289.

Lutzenhiser, L.; Harris, CK.; Olson, ME. Energy, society and evironment. In: Dunlap, RE.; Michelson, W., editors. Handbook of Environmental Sociology. Westport, Connecticut: Greenwood Press; 2001.

Majupuria, TC. Nepal, Nature's Paradise: Insight into Diverse Facets of Topography, Flora, and Ecology. Gwalior, Nepal: Devi; 1999.

Massey DS. Social structure, household strategies, and the cumulative causation of migration. Population Index 1990;56(1):3–26. [PubMed: 12316385]

Massey, Douglas S.; Arango, Joaquín; Hugo, Graeme; Kouaouci, Ali; Pellegrino, Adela; Edward Taylor, J. Worlds in Motion: International Migration at the End of the Millennium. Oxford: Oxford University Press; 1998.

Massey, Douglas S.; Espinosa, Kristin E. What's Driving Mexico-U.S. Migration? A Theoretical, Empirical and Policy Analysis. American Journal of Sociology 1997;102:939–999.

Massey DS, Goldring LP, Durand J. Continuities in transnational migration: an analysis of 19 Mexican communities. American Journal of Sociology 1994;99(5):1492–1533.

Massey, DS.; Taylor, JE. Back to the future: immigration research, immigration policy, and globalization in the 21st Century. In: Massey, DS.; Taylor, JE., editors. International Migration: Prospects and Policies in a Global Market. Oxford: Oxford University Press; 2004. p. 378-388.

Massey DS, Williams N, Axinn WG, Ghimire DJ. Community services and out-migration. International Migration 2010;48(1):1–41. [PubMed: 20645469]

Moran, EF.; Brondizio, E. Land use change after deforestation in Amazonia. In: Liverman, D.; Moran, EF.; Rindfuss, RR.; Stern, PC., editors. People and Pixels: Linking Remote Sensing and Social Science. Washington D.C: National Academies Press; 1998. p. 106-134.

Moran, EF.; Brondizio, E.; Van Wey, LK. Population and environment in Amazonia: landscape and household dynamics. In: Entwisle, B.; Stern, PC., editors. Population, Land Use and Environment. Washington, D.C: National Academies Press; 2005. p. 106-134.

Myers N. Environmental refugees in a globally warmed world. Bioscience 1993;43(11):752–773.

Myers N. Environmental refugees. Population and Environment 1997;19(2):167–182.

Myers, N.; Kent, J. Environmental Exodus: An Emergent Crisis in the Global Arena. Washington, DC: Climate Institute; 1995.

Myers N. Environmental refugees: a growing phenomenon of the 21st century. Philosophical Transactions: Biological Sciences (Royal Society London) 2002;357(1420):609–613.

Niraula BB. Marriage changes in the central Nepali hills. Journal of Asian and African Studies 1994;29(2):91–109.

North, DC. Structure and Change in Economic History. New York: Norton; 1981.

Pearce, LD. Unpublished Ph D dissertation. The Pennsylvania State University; University Park, PA: 2000. The multidimensional impact of religion on childbearing preference and behavior in Nepal.

Perz S. The environment as a determinant to child mortality among igrants in frontier areas of Para' and Rondonia, Brazil, 1980. Population and Environment 1997;18(3):301–24.

Petersen T. Estimating Fully Parametric Hazard Rate Models with Time-Dependent Covariates: Use of Maximum Likelihood. Sociological Methods and Research 1986;14:219–246.

Petersen T. The statistical analysis of event histories. Sociological Methods and Research 1991;19(2): 270–323.

Pokharel BN, Shivakoti GP. Impact of development efforts on agricultural wage labor. Winrock Rural Poverty Research Paper Series. 1986;(1)

Portes A, Sensenbrenner J. Embeddedness and immigration: notes on the social determinants of economic action. American Journal of Sociology 1993;98(6):1320–51.

Rouse RC. Mexican migration and the social space of postmodernism. Diaspora 1991;1(1):8–23.

Rouse RC. Making sense of settlement: class transformation, cultural struggle, and transnationalism among Mexican migrants in the United States. Annals of the New York Academy of Sciences 1992;645(1):25–52.

Sassen, S. The Mobility of Labor and Capital: A Study in International Investment and Labor Flow. Cambridge: Cambridge University Press; 1988.

Schmidt-Vogt D. Deforestation in the Nepal Himalaya: causes, scope, consequences. European Bulletin of Himalayan Research 1994;7(1):18–24.

Seddon, D. Population and poverty in Nepal. In: Rodgers, G., editor. Population Growth and Poverty in Rural South Asia. New Delhi: Sage; 1989.

Shivakoti GP, Axinn WG, Bhandari P, Chhetri NB. The impact of community context on land use in an agricultural Society. Population and Environment 1999;20(3):191–213.

Shivakoti GP, Pokharel BN. Marketing of major crops in Chitwan: a case study of six village panchayats. Winrock Research Paper Series. 1989;(8)

Sjaastad LA. The Costs and Returns of Human Migration. Journal of Political Economy 1962;70(S): 80–93.

Shrestha, NR. Landlessness and Migration in Nepal. Boulder: Westview Press; 1990.

Shrestha, NR. Nepal: the society and its environment. In: Savada, AM., editor. Nepal and Bhutan: Country Studies. Washington, D.C: Federal Research Division, Library of Congress; 1993. p. 53-103.

Shrestha NR, Velu RR, Conway Dennis. Frontier migration and upward mobility: the case of Nepal. Economic Development and Cultural Change 1993;41(4):787–816.

Shrestha VP. Forest resources of Nepal: destruction and environmental implications. Contributions to Nepalese Studies 1999;26(3):295–307.

Stark, O. The Migration of Labor. Cambridge: Basil Blackwell; 1991.

Suhrke, Ai. Environmental degradation and population flows. Journal of International Affairs 1994;47(3):473–96.

Taylor JE, Arango J, Hugo G, Kouaouci A, Massey DS, Pellegrino A. International migration and community development. Population Index 1996;63(3):397–418.

Thacker P. Migration: a strategy for survival in the mountains. Appropriate Technology 1991;17(1): 26–8.

Thapa S. The ethnic factor in the timing of family formation in Nepal. Asia-Pacific Population Journal 1989;4(1):3–34. [PubMed: 12315769]

Thapa, G. Indigenous management of Nepal's natural resources: some policy issues. In: Shivakoti, G.; Varughese, G.; Ostrom, E.; Shukla, A.; Thapa, G., editors. People and Participation in Sustainable Development: Understanding the Dynamics of Natural Resource Systems. Bloomington: Indiana University Press; 1997. p. 290-2898.

Thomas, Brinley. Migration and Economic Growth: A Study of Great Britain and the Atlantic Economy. Cambridge: Cambridge University Press; 1973.

Todaro MP, Maruszko L. Illegal migration and U.S. immigration reform: a conceptual framework. Population and Development Review 1987;13(1):101–14.

Tuladhar, JM. The Persistence of High Fertility in Nepal. New Delhi: Inter-India Publications; 1989.

United Nations University. Environmental refugees: the forgotten migrant. 2007. http://environemnt.about.com/gi/dynamic/offsite.htm/zi=1/XJ&sdn=environment&cdn=newsissues&tm=79&gps=183_454_1148_666&f=00&tt=2&bt=1&bts=1&zu=http%3A//www.unu.edu/

Williams, Nathalie. Education, gender, and migration in the context of social change. Social Science Research 2009;38(4):883–896. [PubMed: 20645440]

Wood, WB. Ecomigration: linkages between environmental change and migration. In: Zolberg, AR.; Benda, P., editors. Global Migrants, Global Refugees. New York and Oxford: Berghahn; 2001. p. 42-61.

Yabiku ST. Marriage timing in Nepal: organizational effects and individual mechanisms. Social Forces 2004;83(3):559–586.

Yabiku ST. Neighbors and neighborhoods: effects on marriage timing. Population Research and Policy Review 2006;25(4):305–327.

Zlotnick, Hania. Population growth and international migration. In: Massey, DS.; Taylor, JE., editors. International Migration: Prospects and Policies in a Global Market. Oxford: Oxford University Press; 2004. p. 15-34.

Figure 1.
Map of the Study Area

Table 1

Definitions, means, and standard deviations of variables used in the analysis of migration and environment in Nepal's Chitwan Valley.

Variable	Definition	Mean	SD
Migration (1997–1999)			
Local	Left ***neighborhood*** on trip >1 month	0.10	0.30
Distant	Left ***valley*** on trip >1 month	0.29	0.45
Environmental conditions (1996)			
Productivity	1 if perceived as declining, 0 otherwise	0.57	0.49
Share green	% neighborhood covered in flora	74.26	22.74
Time for Firewood	Minutes required to gather firewood (00s)	3.42	2.25
Time for Fodder	Minutes required to collect fodder (00s)	1.10	0.78
Density	Persons per 100,000 square feet	19.16	64.94
Theoretical controls (1996)			
Human capital			
Enrolled in school	1 if currently enrolled, 0 otherwise	0.16	0.37
Years of schooling	Years enrolled prior to 1996	5.97	5.87
Has wage job in 1996	1 if now has wage job, 0 otherwise	0.35	0.48
Has salaried job in 1996	1 if now has salaried job, 0 otherwise	0.10	0.29
Social capital			
Local network	1 if HH has local migrant, 0 otherwise	0.23	0.42
Distant network	1 if HH has distant migrant, 0 otherwise	0.42	0.49
Local prevalence	Prop. local migrants in neighborhood	0.08	0.07
Distant prevalence	Prop. distant migrants in neighborhood	0.16	0.12
Physical capital			
Farmland	1 if household owns land, 0 otherwise	0.82	0.38
Equipment	Number of pieces owned	1.81	1.44
Livestock	Number of standardized units	2.63	2.27
House plot owned	1 if house plot owned, 0 otherwise	0.87	0.34
Home quality	Index ranging from 4–18	9.24	3.52
Market access	Minutes walk to nearest market (logged)	1.87	1.22
Demographic controls (1996)			
Gender			
Female	1 if female, 0 if male	0.55	0.50
Age (Birth cohort)			
15–24 (1972–1981)	1 if yes, 0 otherwise	0.36	0.48
25–34 (1962–1971)	1 if yes, 0 otherwise	0.25	0.43
25–44 (1952–1961)	1 if yes, 0 otherwise	0.19	0.40
45–59 (1936–1951)	1 if yes, 0 otherwise	0.20	0.40
Ethnicity			
High Caste Hindu	1 if yes, 0 otherwise	0.47	0.50
Low Caste Hindu	1 if yes, 0 otherwise	0.10	0.30

Variable	Definition	Mean	SD
Hill Tibeto-Burmese	1 if yes, 0 otherwise	0.15	0.36
Newar	1 if yes, 0 otherwise	0.07	0.25
Terai Tibeto-Burmese	1 if yes, 0 otherwise	0.21	0.41

Source: Chitwan Valley Family Study

Table 2

Multilevel hazard model predicting monthly rate of out-migration in Nepal's Chitwan Valley 1997–1999.

	Local Moves		Distant Moves	
Independent variables	**Odds Ratio**	**t-test**	**Odds Ratio**	**t-test**
Environmental conditions				
Perceived productivity decline	1.31*	1.98	1.15*	1.72
Share of neighborhood green	0.98*	−1.87	1.00	0.61
Time to gather firewood	1.1**	2.79	1.03	1.47
Time to collect fodder	1.05	0.62	1.09*	1.68
Population density	0.96	−1.39	1.00	−0.11
Theoretical controls				
Human capital				
Enrolled in school	0.59**	−2.56	0.76**	−2.54
Years of schooling	1.00	−0.30	1.06***	5.57
Currently has wage job	0.68**	−2.76	0.99	−0.11
Currently has salaried job	2.22***	3.70	1.42**	2.40
Social capital				
Household has network tie	1.11	0.64	1.44***	4.52
Neighborhood prevalence	2.35	0.48	3.75*	2.29
Physical capital				
Market access	1.09	0.73	1.03	0.54
Farmland	1.52	1.34	0.70*	−1.78
Equipment	1.20**	3.01	1.01	0.16
Livestock	0.90**	−2.81	0.98	−0.99
House plot owned	0.43***	−3.41	0.98	−0.08
Home quality	0.93*	−2.15	1.02	0.92
Demographic controls				
Gender				
Female	0.63***	−3.35	0.71***	−4.20
Age (Birth cohort)				
15–24 (1972–1981)	6.09***	7.70	2.91***	7.72
25–34 (1962–1971)	3.93***	6.08	1.42**	2.48
25–44 (1952–1961)	2.12***	3.17	0.81	−1.33
45–59 (1936–1951)				
Ethnicity				
High Caste Hindu				
Low Caste Hindu	1.13	0.48	1.21	1.30
Hill Tibeto-Burmese	0.79	−0.94	1.26*	1.83
Newar	1.06	0.17	0.89	−0.57

	Local Moves		Distant Moves	
Independent variables	**Odds Ratio**	**t-test**	**Odds Ratio**	**t-test**
Terai Tibeto-Burmese	1.44	1.46	0.82	−1.36
Duration				
Month	0.92***	−3.67	0.97*	−2.03
Month squared	1.01**	2.63	1.00	0.60
ICC	0.68		0.11	
Deviance	2,395		7,611	
Person Months	68,309		69,333	

*$P<.05$,

**$P<.01$,

***$P<.001$ all probabilities are one-tailed.

Table 3

Multilevel hazard model predicting monthly rate of out-migration separately for males and females in Nepal's Chitwan Valley 1997–1999.

	Local Moves		Distant Moves	
Independent variables	**Males**	**Females**	**Males**	**Females**
Environmental controls				
Perceived productivity decline	1.30^{+}	1.34^{+}	1.19^{+}	1.12
Share of neighborhood green	0.99	0.97**	1.01^{+}	1.00
Time to gather firewood	1.16**	1.03	1.03	1.04^{+}
Time to collect fodder	1.08	1.21^{+}	1.04	1.14*
Population density	0.98	0.96^{+}	1.01	0.98
Theoretical controls				
Human capital				
Enrolled in school	0.60*	0.40**	0.85	0.57***
Years of schooling	0.94**	1.06**	1.04***	1.08***
Currently has wage job	0.67*	0.75^{+}	1.02	0.93
Currently has salaried job	1.82**	11.30***	1.59**	1.47
Social capital				
Household network tie	1.12	1.00	1.36**	1.51***
Neighborhood prevalence	3.01	2.82	6.69**	2.96^{+}
Physical capital				
Access to markets	0.92	1.22^{+}	1.06	0.99
Farmland	1.48	1.20	0.64*	0.67^{+}
Equipment	1.20*	1.16*	1.07^{+}	0.95
Livestock	0.85**	0.93^{+}	0.95*	1.01
House plot owned	0.37**	0.46*	0.70^{+}	1.53
Home quality	0.87***	0.97	0.99	1.05*
Demographic controls				
Age (Birth cohort)				
15–24 (1972–1981)	9.60***	4.43***	4.22***	1.80**
25–34 (1962–1971)	5.82***	3.26***	2.10***	0.80
25–44 (1952–1961)	1.87*	2.68**	0.88	0.66*
45–59 (1936–1951)				
Ethnicity				
High Caste Hindu				
Low Caste Hindu	0.50*	1.88*	1.23	1.09
Hill Tibeto-Burmese	0.57*	1.14	1.25^{+}	1.21
Newar	0.51	2.28*	0.82	0.97

	Local Moves		Distant Moves	
Independent variables	**Males**	**Females**	**Males**	**Females**
Terai Tibeto-Burmese	0.67^{+}	2.38**	0.83	0.83
Duration				
Month	0.94*	0.91**	0.96**	1.00
Month squared	1.00^{+}	1.01*	1.01^{+}	1.00
ICC	0.69	0.65	0.17	0.12
Deviance	1,166	1,180	3,798	3,721
Person Months	29,434	38,875	29,562	39,771

Source: Same as Table 1

$^{+}$*P*<.10

**P*<.05,

***P*<.01,

****P*<.001 all probabilities are one-tailed.

Table 4

Multilevel hazard model predicting monthly rate of out-migration separately for high caste Hindus and other ethnic groups in Nepal's Chitwan Valley 1997–1999.

	Local Moves		Distant Moves	
Independent variables	**High Caste**	**Other**	**High Caste**	**Other**
Environmental conditions				
Perceived productivity decline	0.93	1.48*	1.06	1.29*
Share of neighborhood green	1.00	0.97*	1.00	1.00
Time to gather firewood	1.00	1.17***	1.04	1.01
Time to collect fodder	1.05	1.10	1.15*	1.12+
Population density	0.97	0.97	1.01	0.99
Theoretical controls				
Human capital				
Enrolled in school	0.84	0.44**	1.04	0.55***
Years of schooling	1.02	0.98	1.08***	1.06***
Currently has wage job	0.58**	0.80	0.83+	1.23*
Currently has salaried job	1.46	2.61***	0.87	1.95***
Social capital				
Household network tie	2.18***	0.70*	1.48***	1.44***
Neighborhood prevalence	0.99*	47.41*	1.50	13.62***
Physical capital				
Access to markets	0.84	1.15	1.04	1.02
Farmland	6.75*	1.22	0.54+	0.70+
Equipment	1.10	1.29***	0.98	1.00
Livestock	0.91*	0.90*	0.99	0.97
House plot owned	0.10***	0.56*	1.43	0.80
Home quality	0.88**	0.96	1.01	1.04+
Demographic controls				
Gender				
Female	0.64*	0.59**	0.79*	0.63***
Age (Birth cohort)				
15–24 (1972–1981)	3.28***	9.33***	1.87**	3.61***
25–34 (1962–1971)	2.98***	5.68***	1.22	1.44*
25–44 (1952–1961)	1.32	2.73***	0.75+	0.82
45–59 (1936–1951)	----	----	----	----
Duration				
Month	0.94*	0.92**	0.98	0.97+
Month squared	1.00+	1.01*	1.00	1.00
ICC	0.76	0.68	0.16	0.13

	Local Moves		Distant Moves	
Independent variables	**High Caste**	**Other**	**High Caste**	**Other**
Deviance	970	1,364	3,911	3,631
Person Months	33,119	35,190	33,784	35,549

Source: As for Table 1

$^{+}P<.10$

$^{*}P<.05$,

$^{**}P<.01$,

$^{***}P<.001$ all probabilities are one-tailed.