Population Mobility and Livelihood Diversification among Indigenous Peoples of the Ecuadorian Amazon

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ABSTRACT

Jason Lee Bremner: Population Mobility and Livelihood Diversification among Indigenous Peoples of the Ecuadorian Amazon
(Under the direction of Richard Bilsborrow)

Throughout the Amazon, new roads, infrastructure, oil pipelines, colonist settlements, and mechanized agriculture, however, suggest an uncertain future for indigenous peoples. Indigenous communities of the Amazon are undergoing intense socio-economic, demographic, and cultural changes. There has been limited quantitative inquiry, however, into the determinants of change occurring among indigenous populations. The primary objective of this research is to examine the determinants of two important aspects of change occurring in indigenous populations: the adoption of non-farm employment (often referred to as livelihood diversification) and out-migration. Non-farm employment and out-migration may have unforeseen impacts, both positive and negative, on families, communities, and resource management institutions, and as such on the well-being of indigenous people and their lands. This research addresses the question, "What are the individual, household, and contextual factors that lead indigenous households to decide to diversify livelihoods and participate in non-farm employment, or to have a member of the household move away temporarily or permanently?" The research draws upon livelihoods and migration theories to examine population mobility among the indigenous. Household and community survey data and multi-level models are employed to make inferences about determinants of these important behaviors and their link to future resource use and livelihoods in the Amazon.

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LIST OF ABBREVIATIONS

CEPAR- Centro de Estudios de Población y Desarollo Social

DIFD – Department for International Development

FAO – Food and Agriculture Organization of the United Nations

GPS- Global Positioning System

GIS- Global Information System

GLLAMM – Generalized Linear Latent and Mixed Models

INEC- Instituto Nacional del Census

NEA - Northern Ecuadorian Amazon

NELM- New Economics on Labor Migration Theory

NFTPs- Non-Timber Forest Products

TFR - Total Fertility Rate

UNDP – United Nations Development Program

Chapter 1

Introduction

1.1 Motivation

The Upper Amazon Basin remains largely undeveloped and is part of the larger Amazon Major Tropical Wilderness Area, one of the largest remaining continuous tropical forests left on the planet (Mittermeier 2003; Myers et al. 2000). Conservation of the Amazon Basin is of international significance for several reasons. First, the Amazon likely contains the greatest amount of plant and animal biodiversity on the planet; second, the Amazon is important for global climatic processes and carbon cycles, and finally, indigenous and traditional forest people depend on the forest for their livelihoods.

Since the 1970's, however, the Amazon basin has experienced rapid development and deforestation. Despite more than a decade of effort by local and international conservation groups and governments, annual rates of forest loss in the Amazon during the last decade were among the highest on record (INPE 2011). Deforestation in much of the Brazilian Amazon appears to follow a path of logging, pasture for cattle ranching, and conversion to agriculture for soybean production (Brown et al 2005), and Brazil is now the world's largest producer of soybeans and second largest producer of beef behind the United States (USDA/FAS 2012a; USDA/FAS 2012b). The conservation of remaining forests becomes increasingly important as agricultural landscapes in the Amazon grow and increasingly threaten the functioning of the tropical rainforest ecosystem.

Indigenous populations have inhabited the Amazon for millennia, and still populate most of the remaining areas of tropical forest. After decades of population decline, indigenous populations of the lowland tropics of Latin America are experiencing an apparent demographic turnaround and are now increasing in size (Bremner et al., 2008; Kennedy and Perz 2000; McSweeney and Arp 2005, Perz et al, 2008). At the same time indigenous populations in many parts of Latin America have become increasingly prominent actors in local, national, and international politics (Laurie et al. 2005; Perreault 2001; Perreault 2003; Valdivia 2007; Yashar 2004; Yashar 1999; Yashar 1998). There has also been a trend in international environmental discourse favoring "traditional knowledge" and indigenous agroforestry as models for environmental conservation (Valdivia, 2005).

Together, the population growth, political activism, and increased attention from environmentalists can be thought of as a resurgence of indigenous populations. At the same time indigenous groups have gradually gained legal land rights to their lands, and are considered a critical barrier to future deforestation (Fearnside 2003; Nepstad et al. 2006; Schwartzman and Zimmerman 2005;).

Throughout the Amazon, new roads, infrastructure, oil pipelines, colonist settlements, and mechanized agriculture, however, suggest an uncertain future for indigenous peoples. Case studies reveal that indigenous communities of the Amazon are undergoing intense socio-economic, demographic, and cultural changes (Godoy et al 2009; Godoy et al 2005; Rudel et al. 2002a; Lu 2001; Godoy et al 1997; Heinrich 1997). There has been limited quantitative inquiry, however, into the determinants of change occurring among indigenous populations at the household level. Existing studies typically suffer from small samples of communities and households, and lack multivariate analysis (e.g., Rudel et al. 2002b; Henrich 1997; Santos et al.

1997; for exceptions see Godoy et al 2009; Godoy et al 2005; and Godoy et al 2001; Gray et al 2008). Successful conservation/development policies that conserve biodiversity, promote sustainable livelihoods, and improve the lives of indigenous peoples depend on a better understanding of the complex dynamic of demographic, ecological, socio-economic, and cultural factors influencing indigenous resource use and livelihoods. Furthermore, such knowledge must be gathered at multiple scales including the individual, household, and community.

1.2 Scope and method

The primary objective of this dissertation is to examine the determinants of two important aspects of change occurring in indigenous populations: the adoption of non-farm employment (often referred to as livelihood diversification) and out-migration. Non-farm employment and out-migration may have unforeseen impacts, both positive and negative, on families, communities, and resource management institutions, and as such on the well-being of indigenous people and their lands. This research addresses the question, "What are the individual, household, and contextual factors that lead indigenous households to decide to diversify livelihoods and participate in non-farm employment, or to have a member of the household move away temporarily or permanently?"

Prior research related to livelihood diversification and migration has not specifically examined indigenous populations. In the Ecuadorian Amazon, non-farm employment is now an important livelihood strategy for indigenous households. Approximately, 50% of households surveyed for this research had participated in non-farm employment during the past year, and among one particular ethnic group, more than 80% of households had participated in wage employment, principally in manual labor for oil companies.

Out-migration of young members of the household to urban areas or to other rural areas for employment is also a common livelihood strategy for individuals and households. Among the indigenous households surveyed for this research, approximately one third reported that a member of the household had out-migrated from the community. Approximately one third of the out-migrants had moved to cities in the region, with the majority of these being young people seeking employment or education.

Because past research has shown that livelihoods vary greatly according to location, assets, social relations, and opportunity (Ellis 1998), proper understanding of the livelihood diversification process among indigenous populations requires analysis at multiple levels. I suspect that indigenous households respond to changes in different ways related to their assets, capabilities, and available opportunities, and that these responses are mediated at the community level by social institutions and local context. Furthermore, I expect that different ethnic groups will show different levels of participation in non-farm employment and out-migration even when controlling for household and community-level determinants. As such, this study will highlight the importance of multi-level and cross-cultural analysis when studying livelihoods.

1.3 Organization

This dissertation is organized into chapters and subsections. The second chapter is a review of select literature on the history of indigenous populations in the Amazon and a more complete review of literature on recent social and environmental change among Amazonian indigenous people. Purposefully omitted from this review is the rich ethnographic literature coming from cultural anthropology focused on the character of indigenous societies of the Amazon, as it is not highly relevant to the specific literature of this dissertation. Chapter 3

introduces the livelihoods framework as a useful approach, reviews the bodies of literature on livelihood diversification and population mobility and finds commonalities between the two, and presents a conceptual framework and hypotheses for the research question of this dissertation. Chapter 4 describes the study area and study population, as well as the sampling and data collection. Chapter 5 describes the methods used for this research, the data processing that was required and resulting data structure, and the specific models used for the study of livelihood diversification and out-migration. Chapter 6 presents descriptive results for the study population, their livelihoods, and their migration. Chapter 7 contains multivariate statistical results and discussion related to livelihood diversification, and Chapter 8 contains the statistical results and discussion related to out-migration. Chapter 9 compares the results from the two different models of livelihood strategies, draws conclusions from the findings, assesses policy ramifications, and addresses the limitations of this research and needs for further research.

Chapter 2

Indigenous populations and environmental change in the Amazon

2.1 Introduction

Cultural anthropologists have studied indigenous populations for decades and there is a rich body of ethnographic literature that documents the cultural practices and resource use of many of the ethnic groups of the Amazon. While valuable in its own right, a literature review of Amazonian ethnography is beyond the scope of this dissertation. The goal of the chapter is to provide context for the current socio-political environment facing indigenous populations in the Amazon and to discuss recently observed changes occurring among these populations.

Chapter 2 is divided into four parts. The first section discusses the history of early contact of indigenous populations in the New World and the rapid changes and decline that occurred as indigenous populations succumbed to exploitation and disease. The second section discusses the resurgence of indigenous populations both politically and demographically. The third section focuses on past and present environmental discourse regarding indigenous peoples. The final section reviews literature more specific to recent changes occurring among indigenous populations, focusing specifically on literature related to market integration, migration, and land use.

2.2 History of indigenous populations in the Amazon

Relatively little is known about Pre-Columbian Indigenous Amazonian populations, but estimates of the size of the indigenous population in all of Latin America prior to 1492 range widely from a low end of just under 10 million to a high end estimate of over 100 million (Denevan 1972). The validity of these estimates (particularly the high end) has been called into question (Henige 1998), but regardless of the estimate, the rapid decline of indigenous populations in the Americas following contact with Europeans is well documented. During the sixteenth and seventeenth century, disease, enslavement, and conflict ravaged indigenous populations (Cook 1998; Sánchez-Albornoz 1974; Verano and Ubelaker 1992; Whitmore and Turner 1992), and by the late eighteenth century indigenous populations in many areas likely reached their historic low points (Denevan 1972). Because of the variability of initial estimates of the indigenous population, it is difficult to assess the overall scale of this population decline; hence it is difficult to compare today's indigenous population with past figures.

The spiraling decline in numbers was accompanied by other gradual but radical changes, including: the coerced or forced settlement of nomadic groups, the adoption of Christianity, the amalgamation of some groups, and the adoption of a lingua franca. These changes resulted in an indigenous population that by the mid-twentieth century was largely disenfranchised and powerless locally, regionally, and nationally. Indigenous populations have now experienced changes spanning centuries and as such contemporary research should think of current changes as part of a historic and on-going process of change.

2.3 Resurgence of indigenous populations

Data from the censuses throughout Latin America indicate that after decades of population decline, indigenous populations of the lowland tropics of Latin America are experiencing a demographic turnaround (Kennedy and Perz, 2000; McSweeney and Arps, 2005, Perz et al., 2008). The demographic growth appears to be caused by high fertility rates and declining mortality rates as well as an increase in the numbers of people who report themselves to be indigenous (McSweeney and Arps, 2005; Perz et al., 2008). A recent study of fertility rates among 15 indigenous populations in the Amazon reported a mean total fertility rate of 7.5 (TFR) with groups ranging from 3.9-10.5 (McSweeney and Arps, 2005). In the Northern Ecuadorian Amazon (NEA) the TFR in 2001 for the indigenous population was estimated to be 8.3[1] (Bremner et al., 2008), which is substantially higher than the rate in rural Ecuador (4.4) or among rural mestizos in the NEA (5.0) (Carr et al., 2006). The reasons for this high fertility have not yet been explored, however it is likely that declines in mortality rates along with this high fertility have contributed to a large proportion of indigenous population growth.

At the same time, Perz et al. found that people in Brazil are now more likely to report themselves as indigenous when asked about ethnicity in the national census than they were ten years ago (2008). The reasons for this phenomenon are not yet entirely clear. Valdivia reports that neoliberal reforms and struggles for social justice and environmental conservation have led to changes in indigenous identity (Valdivia, 2005), which perhaps impacts the legitimacy of representing oneself as indigenous.

This resurgent indigenous identity and the accompanying struggles for social justice and environmental conservation have led to growing roles for indigenous people in local, national,

[1] The TFR using traditional methods of calculation was 7.6, but using more appropriate indirect methods, the TFR was estimated to be the higher figure of 8.3

and international politics (Laurie et al., 2005; Martin, 2003; Perreault, 2001; Perreault, 2003; Valdivia, 2007; Yashar, 2004; Yashar, 1999; Yashar, 1998). This indigenous resurgence has been accompanied by increased legal recognition of indigenous land rights. Throughout the Amazon, indigenous groups are increasingly gaining legal rights to their ancestral lands. These rights have generally taken the form of three main tenure types: indigenous reserves under which an indigenous group is given legal communal land title to large areas containing multiple communities; community tenure in which communities are given legal title through customary land tenure laws established for colonists; and finally protected areas, under which the state maintains public ownership of land in protected areas but grants legal use rights to indigenous inhabitants (Richards, 1997). Through these different tenure types, indigenous lands now encompass the single largest category of protected area in the Amazon, and indigenous lands have been touted as a critical barrier to future deforestation (Fearnside, 2003; Nepstad, 2006; Schwartzman and Zimmerman, 2005).

2.4 Indigenous peoples and environmental discourse

While some see indigenous peoples as key to the future of Amazon forests, the role of indigenous peoples in conservation has long been highly debated in the conservation literature. This debate has tended to dwell on whether or not indigenous peoples are inherently conservationists (Alcorn, 1993; Carneiro da Cunha, 2000; Colchester, 2000; Peres, 1994; Redford and Stearman, 1993a, 1993b; Terborgh, 2000). Critics of indigenous lands as conservation areas assert that dispersed and small population size; small-scale agriculture, hunting, fishing, and gathering of non-timber forest products; “traditional” technologies; and subsistence economies are what account for ecologically intact indigenous territories (Kramer &

van Schaik, 1997; Oates, 1999; Smith, 2001; Terborgh, 2000). They claim that as these characteristics change, so too will indigenous environmental stewardship. In contrast, proponents of indigenous lands emphasize that indigenous peoples have strong connections to and knowledge of ecosystems (Posey & Balée, 1989); that they deter encroachment by outsiders (Alcorn, 1993); and that they are key conservation allies (Brechin et al, 2002). Despite this debate, many conservation organizations now recognize the importance of working with indigenous people, and several of the largest international organizations have created specific indigenous peoples programs or explicitly focus on the role of indigenous peoples in conservation, including but not limited to: World Wildlife Fund for Nature, Conservation International, Wildlife Conservation Society, and the International Union for the Conservation of Nature.

For the most part, environmental discourse on indigenous peoples, however, has tended to rely on little empirical data, in part because of limited empirical studies comparing indigenous land uses and livelihoods with other users. Recent research, however, has begun to shed light on indigenous land use. Using an extensive collection of satellite imagery, researchers confirmed that indigenous areas have, over the last several decades, been protective overall of forests (Nepstad et al., 2006). Recent research comparing colonist and indigenous land use through a combination of satellite imagery and household surveys in the Ecuadorian Amazon, also found that deforestation and forest fragmentation are significantly greater for colonists than indigenous households (Lu et al., 2010).

There is still relatively little understanding, however, of how indigenous lives, livelihoods, and social structures are changing, and whether these changes will impact indigenous land and resource use and the important community institutions and decision-making

structures, such as communal tenure arrangements and indigenous federations that shape Amazonian indigenous peoples' patterns of resource use. Also largely absent from the discourse are discussions about changing mobility patterns among indigenous peoples, and the impacts these changes might have on households, institutions, and indigenous lands.

2.5 Markets, changing livelihoods, and out-migration

Changing livelihoods and changing mobility patterns may have unforeseen impacts, both positive and negative, on families, community institutions, and the well-being of indigenous peoples. The most commonly cited definition of a livelihood is the following:

> "A livelihood comprises the assets (natural, physical, human, financial, and social capital), the activities, and the access to these (mediated by institutions and social relations) that altogether determine the living gained by the household or individual." (Ellis, 2000)

Prior research on livelihoods has not specifically examined indigenous populations, though there is a body of literature focused on the concept of market integration, which overlaps conceptually with the literature on changing livelihoods. Cultural anthropologists have examined the socio-cultural, demographic, and economic impacts of indigenous people's interaction with markets. Some of the many changes occurring as indigenous peoples increasingly interact with markets include: changes in land use (Godoy, et al., 2000; Godoy et al., 1997; Henrick, 1997; Rudel et al., 2002), dependence on forest-products (McSweeney, 2004), food sharing (Lu, 2001), settlement patterns (Rudel et al., 2002), and consumption preferences (Henrich, 1997). In general the process of market integration has been depicted as negative for indigenous peoples, and some of the suggested impacts have included: loss of cultural traditions, knowledge, and traditional practices; environmental degradation; and declining health.

Only more recently have anthropologists become concerned with questions of why, if faced with these negative consequences, indigenous peoples participate in markets (Godoy, 2001). The process through which indigenous people increasingly interact with markets is often referred to as market integration. The concept of market integration however, is measured in variable ways and is inconsistently defined (Lu, 2007). Godoy et al. (2005) conceptualize a linear continuum of market integration, with autarky or complete self-sufficiency at one end of the spectrum and complete dependence on markets at the other. Importantly, they note that people often shift in both directions along this spectrum as opportunities and limitations come and go (Godoy et al., 2005). The idea of shifting along a spectrum of market integration fits well with the dynamic nature of livelihoods in which seasonally and annually, livelihoods may change according to available assets, opportunities, and mediating contextual factors.

There have been some notable works in the anthropological literature that have explored the determinants of market integration (Gross et al, 1979; Henrich, 1997). Gross et al. (1979) looked specifically at circumscription or the pressure of outsider encroachment on subsistence production as the factor forcing indigenous people to seek sources of food in markets. Henrich (1997) argued that market participation by the Machiguenga in the Peruvian Amazon was not compelled by external forces but instead that the Machiguenga were eager participants in the market and seeking opportunities to participate. Godoy et al. (2005) propose that both push factors (population pressure and circumscription) and pull factors (desire to increase consumption, the desire to diversify and thus smooth consumption, and the allure of foreign/modern goods) be considered in the study of the determinants of market integration.

Godoy (2001) explores a few prominent theoretical explanations on why people participate in markets, including the developmental economics model, political-economy, and

the Gross et al model. He suggests that theory on the determinants of market integration should borrow from each of these while also incorporating ideas of comparative advantage from macroeconomics and household economic behavior from microeconomics (Godoy 2001). Unfortunately, while Godoy discusses the importance of an integrated theory on the determinants of market integration, he does not clearly lay out a conceptual framework.

Godoy (2001) in his research on market integration makes important contributions to our understanding of livelihood diversification among indigenous peoples. First, as mentioned above, he conceptualizes market integration as a bi-directional process, suggesting that indigenous households may respond to market opportunities (non-farm employment opportunities and changing agricultural prices) when they are present, and return to subsistence when those opportunities cease to exist. Second, he proposes several hypotheses related to the determinants of market integration, which overlap with ideas of risk management, seasonality, labor markets, and coping behavior from the livelihoods framework. Third, he focuses on households as his unit of analysis, which is in contrast to much past work among anthropologists, which has tended to focus on communities or at a larger scale, particular indigenous groups (Chagnon, 1997; Early and Peters, 1990; Gross et al, 1979; MacDonald, 1999; Ziegler-Otero, 2004). This is important because it recognizes heterogeneity within communities in terms of diversification, and allows us to consider the social and political context in which household decisions are made. As has been noted, social relations and institutions at the household level, community level, ethnic group level, or higher level may all play a role in mediating livelihood decisions.

This dissertation contributes to the literature on indigenous livelihoods because to date there has not yet been an explicit focus on non-farm employment among indigenous people. It

may be that by participating in non-farm employment, indigenous households are able to experiment with markets and gain access to capital through minimal monetary investment. Other market activities such as cash cropping, timber, and cattle ranching may require greater initial costs in terms of financial capital (cash or credit), physical capital (equipment), and human capital (in terms of labor and knowledge of new agricultural systems). Thus we might hypothesize that local non-farm employment is seen as a low cost way to generate cash income in comparison with intensification or extensification of land uses. Conversely, non-farm employment might be an activity with high costs since it could require an extended absence from the household as well as Spanish language skills, and makes individuals vulnerable to exploitation by employers.

Another form of diversification not explored in the market integration literature is permanent out-migration. Similar to non-farm employment, we might hypothesize that the financial, physical, and human capital costs for out-migration might be less than those required for shifts in land use, but the costs must exceed those of non-farm employment. Thinking in this manner of different activities (subsistence and market agriculture, hunting and fishing, non-farm employment, etc.) as a group of dynamic strategies that shift in importance according to changes in assets and opportunities demands a closer examination of the livelihoods concept. Chapter 3 will focus on the livelihoods concept and livelihoods literature, which is useful for conceptualizing the changes occurring among indigenous households.

Chapter 3

Conceptual framework

3.1 Introduction

This chapter is divided into four parts. First, a more specific definition for the concept of a livelihood is introduced and a conceptual framework for livelihood analysis is presented. The second section reviews literature on the determinants of livelihood diversification. The third section reviews the literature on population mobility and its determinants, and discusses commonalities between that literature and the livelihoods literature. The final section presents a conceptual framework for the research question of this dissertation.

3.2 The livelihoods framework

3.2.1 Definitions and concepts

The rural livelihoods approach is a conceptual framework that holds promise for improving understanding of the changes occurring among indigenous populations, and potentially for answering the research question of this dissertation, ""What are the individual, household, and contextual factors that lead indigenous households to decide to diversify livelihoods and participate in non-farm employment, or to have a member of the household move away temporarily or permanently?". The livelihoods concept was originally developed and defined by Chambers and Conway (1992) and was further developed by Scoones (1998) and Ellis (1998; 2000). The definition of a livelihood they developed is as follows:

> "A livelihood comprises the assets (natural, physical, human, financial, and social capital), the activities, and the access to these (mediated by institutions and social relations) that altogether determine the living gained by the household or individual." (Ellis, 2000)

A household in this context is defined as those individuals forming a social group that resides together in the same residence or dwelling and can be considered to be pooling resources for daily consumption[2]. The focus on the household as the primary unit of analysis, however, does not preclude considering characteristics of individuals living within households as well as higher-level contextual characteristics (Ellis, 2000).

In the definition of a livelihood, natural capital refers to the natural resources available for livelihood activities. Physical capital refers to assets created through the economic production process, such as tools, machinery, or land improvements such as roads or irrigation canals. Human capital refers to the education level, work skills, and health status of individuals. Financial capital refers to available financial resources (cash, credit, or collateral) that can be accessed in order to purchase production or consumption goods. Finally, social capital refers to the social networks and associations that people participate in and that can support or inhibit livelihoods (Ellis, 2000). Not explicit in this definition, but an important aspect of the livelihood concept, is the idea that a livelihood is a dynamic set of activities that may change seasonally according to available opportunities and available assets, or change from year to year in relation to economic trends, exogenous shocks, and changing social institutions (Ellis 1998; 2000; Scoones, 1998).

The terms livelihood and income are linked but not synonymous. The concept of a livelihood refers to both the cash earning component of income and the non-monetary contributions to income that come from subsistence production, payments received in kind, and

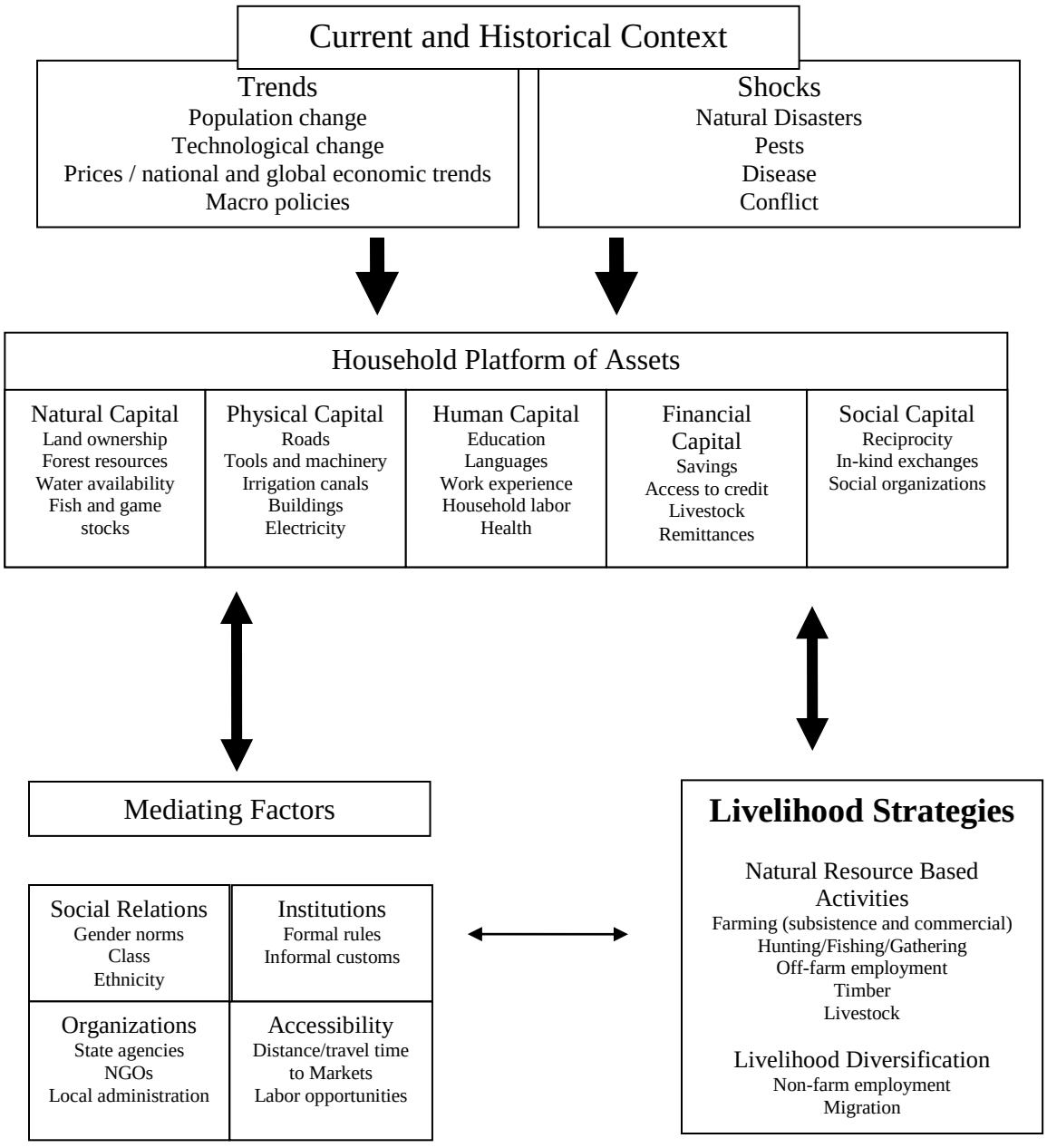
[2] This definition, commonly thought of as eating out of the same pot, comes from the United Nations census recommendations.

transfers and exchanges between households. The combination of cash income and non-monetary income, which constitutes a livelihood, can be subdivided into different sources or activities. The list of livelihood activities that rural households depend upon is lengthy and may include: agriculture and other natural resource activities (cash crops, subsistence crops, cattle ranching, hunting, fishing, logging, and collecting of non-timber forest products), farm employment (working as an agricultural laborer on someone else's farm), non-farm work (wage employment and self-employment not related to agriculture), and migrant remittances. In the simplest conceptualization, households are thought of as constructing livelihoods through decisions about farm intensification and extensification, by deciding to diversify and include non-farm employment activities, or by migrating away temporarily or permanently to seek a livelihood elsewhere.

Common in the literature is the idea of diverse livelihoods, which addresses the fact that it is common for rural households to develop diverse sets of livelihood activities. Reviews of the livelihoods literature from Africa (Barrett et al, 2001; Ellis, 1998; Reardon, 1997) and Latin America (Reardon et al, 2001; Swinton et al, 2003) suggest that diverse rural livelihoods are the norm. A diverse livelihood directly conflicts with past tendencies by rural development professionals to categorize rural households according to a single occupation (e.g. agriculturalists, fisherman, agricultural laborers, etc.) (Chambers, 1995).

A graphical representation of the livelihoods framework is useful for organizing key concepts. The framework depicted in Figure 1 was developed by Scoones (1998) and later adapted by Ellis (2000). I have adapted the framework slightly to include livelihood diversification and migration as possible livelihood activities.

Figure 1. A conceptual framework of livelihood diversification. Adapted from Ellis (2000)



Two aspects of the figure not yet discussed are current and historical context and mediating factors. Both historical and contextual factors may play an important role in determining the livelihood strategies chosen by households. As such, research on livelihoods should consider both household variables and higher-level variables at the community and regional levels. Moreover, ideally livelihoods research should include longitudinal data or retrospective data to account for historical factors that may play a role in determining current livelihood activities. Additionally, it is important to note that a household's livelihood activities may be mediated by other factors. Gender norms for women, for example, might preclude the adoption of certain livelihood activities by women in spite of opportunities and the platform of available household assets. Similarly, social institutions such as common property regimes could create formal rules limiting forest resource use that could influence a household's decision to adopt forest-based livelihood activities. Other important considerations are the role of external organizations and accessibility in determining livelihood activities. Hence, mediating factors also suggest the need for data from multiple levels, but also point to the challenge of considering the role of complex social relations and institutions in livelihood models.

The livelihoods framework currently dominates development discourse. Bilateral, multilateral, and non-governmental development organizations such as the United Kingdom Department for International Development (DIFD), the United Nations Development Program (UNDP), the Asian Development Bank , and CARE all have missions or approaches that specifically focus on sustainable livelihoods as a means of alleviating poverty. The livelihoods framework has also become a prominent topic of academic research. A simple literature search using the term "livelihoods" in Web of Science results in over 1500 articles and spans a diverse collection of journals such as World Development, the Annals of the Association of American

Geographers, Food Policy, and Marine Policy, to name a few. Some of this research has focused on the value of the framework for analyzing rural poverty (Bebbington, 1999; Chambers, 1995). Another focus of livelihoods research has been the analysis of changes in livelihoods, most specifically the diversification of rural livelihoods to include non-farm income (Barrett et al., 2001; Ellis, 2000; Reardon, 1997; Reardon et al. 1992). Environmental discourse and research have also focused on the livelihoods framework, and there are many studies analyzing the creation of sustainable livelihoods as a means of mitigating environmental impacts of rural livelihoods while alleviating rural poverty (Coomes and Barham, 1997; Coomes et al., 2004; Sunderlin et al., 2005; Takasaki et al., 2001)

3.2.2 Livelihood diversification

Livelihood diversification refers to the process by which households adopt a new portfolio of livelihood activities in order to better their standard of living or minimize their risk (Ellis 1998). In practice, however, livelihood diversification is most frequently used to imply diversification away from farming as the predominant means of rural survival (Ellis, 2000; Reardon, 1997). Studies of rural households in Africa have identified non-farm employment as the most prominent form of livelihood diversification (Ellis, 1998; Reardon, 1997). Likewise, studies in Latin America in the 1990's indicated that rural non-farm income on average accounted for 40% of household income (Swinton et al, 2003). A study in Peru from 1985-1997 found that non-farm income accounted for 51% of total rural household income (Escoval, 2001). Research on a colonist population in the same Northern Ecuadorian Amazon study area as this

found that 55% of colonist households engaged in off-farm employment (Bilsborrow et al., 2004).[3]

One necessary clarification is that the process of diversification away from farm activities may not necessarily lead to a more diverse livelihood. For example, a household receiving 80% of its income and subsistence from farm activities and 20% from non-farm sources may decide to change livelihood activities to obtain only 20% from farm activities and 80% from non-farm activities. In this case, it can be argued that livelihood diversification is used as a substitute for farm activities but does not lead to a more diverse livelihood. Thus, livelihood diversification should be clarified as simply referring to the *shifting away* from farm and natural resource based activities, which does not always lead to a more diverse livelihood.

Further clarification is also needed regarding the use of the terms non-farm employment and off-farm employment. These terms are often interchanged in the literature, though conceptually are not necessarily equivalent. A complete discussion of the differences between non-farm and off-farm employment can be found in reviews of livelihood diversification (Ellis 1998, 2000; Reardon, 1997). Non-farm employment is most often defined as all activities outside of the agricultural sector regardless of location. These activities include: employment in rural non-farm labor, self-employment in the local non-farm sector, rental income from leasing land or property, and migrant remittances. Off-farm employment as defined by Ellis (2000) refers only to employment as a farm laborer. Part of the confusion related to these definitions is that Barrett et al. (2001) define off-farm employment very differently in their conceptual review of livelihood diversification. Barrett et al (2001) define off-farm employment according to

[3] The definition of off-farm employment used by Bilsborrow et al., (2004) differs somewhat from the non-farm employment used in this dissertation and approximately 75% of the off-farm employment among the colonist population is as hired agricultural labor.

location; hence an activity of any type that takes place away from the home farm is considered off-farm employment. While in past research myself and others working on the NEA project have relied on the spatial aspect of the off-farm employment definition (Barbieri, 2005; Bremner et al, 2005; Pan et al, 2004), for this research I have returned to the definitions of non-farm and off-farm employment originally proposed in the livelihoods framework. The specific operational definition of non-farm employment used for modeling in this dissertation is described in greater detail in Chapter Five, but in brief, I conceptualize non-farm employment as a shift away from natural resource based-livelihoods regardless of location.

As was mentioned above, many studies have analyzed the shift away from agrarian livelihoods and towards non-farm employment. In general, findings from studies on the determinants of livelihood diversification attribute the decision to both push and pull factors (Barrett et al. 2001). Similarly, the decision is conceptualized as being associated with factors related to necessity versus choice (Ellis, 2000). Push or necessity factors might include diminishing returns of an activity, financial or agricultural policies, environmental crisis, land or credit constraints, and absence of markets, while pull or choice factors might include emerging labor markets, seasonality of production activities, availability of new technologies and/or skills, or changing consumption preferences (Scoones, 1998). This dichotomy, while useful as a conceptual tool, does not expose the complexity of local circumstances that contribute to livelihood diversification (Ellis, 1998).

As an alternative to this conceptualized dichotomy, Ellis proposes three main theories to explain livelihood diversification: seasonality, labor markets, and risk management/coping behavior (2000). The theory of seasonality is based on the idea that the seasonality of agriculture can lead to large intra-annual fluctuations in both income and labor expenditures. Thus,

households diversify their livelihoods in order to reduce income instability and smooth consumption. Additionally, households are able to easily diversify since labor expenditures may be low during off-peak periods. A relationship between seasonal agriculture and livelihood diversification suggests that at the household-level one should not see a relationship between cultivated land and participation in non-farm employment, since labor expenditures in agriculture would not preclude participation in the other.

Alternatively, the labor market theory surmises that when marginal returns to time spent laboring in agriculture fall below the gains attainable through the wage rate or self-employment, the household will choose to diversify to non-farm activities (Ellis, 2000). Both human capital factors (education and work experience) and mediating factors (gender norms, ethnic norms, and accessibility of labor opportunities) are likely to impact labor market returns and thus have an important impact on decisions regarding livelihood diversification. Furthermore, factors that impact returns from farm-based activities such as access to markets, crop prices, availability of credit, and land constraints should also be correlated with decisions regarding livelihood diversification.

Finally, the risk management theory is based on the idea of diversifying activities in anticipation of or to mitigate a threat to any single livelihood activity. Risk management should be distinguished from coping behavior. The key distinction is that risk management is related to diversification that occurs before an actual crisis has occurred whereas coping behavior occurs in response to some crisis that affects the household livelihood. Both of these theories depend upon the concepts of vulnerability, resilience, and sensitivity. Vulnerability is defined as a high degree of exposure to risk, shocks, or stresses (Davies, 1996), and resilience refers to the ability of a system (natural or social) to withstand stress and or shocks (Blakie and Brookfield, 1987).

Vulnerability and resilience are expected to be associated with the assets available to households, including all of the forms of capital: natural, human, physical, financial, and social.

Most empirical research has focused on the risk management theory of livelihood diversification, and the theory leads to a number of seemingly contradictory predictions. In relation to household assets and land holdings, theory predicts that wealthy households will be less risk averse and therefore more open to experimenting with new livelihoods. At the same time, however, poor households might also be compelled to diversify as a risk dispersal strategy in order to smooth potential fluctuations in consumption (Reardon et al., 1992). Another ambiguous prediction is related to financial and human capital. Access to credit and education are hypothesized to be barriers to diversification. Hence, those who have more education and access to financial capital should have a greater ability to diversify into new activities. At the same time, however, diversification is often hypothesized to be a means of attaining capital in underdeveloped credit markets, meaning that those with limited access to credit may be more inclined to diversify, though they may be less able to do so due to capital constraints (Ellis, 2000).

Empirical research has revealed that both the determinants and the impacts of livelihood diversification are highly context dependent (Ellis, 1998). Findings on household characteristics such as household size, household composition, and household life cycle, for example, have not revealed consistent findings (Barrett et al. 2001; Murphy 2001; Reardon et al, 1992). Two key findings, however, that are repeatedly supported in studies of the determinants of diversification are: first, there is a positive relationship between education and diversification; and second, greater physical access to markets is consistently positively associated with diversification (Barrett et al, 2001; Escoval, 2001; Ellis, 1998).

3.3 Population mobility and livelihoods

3.3.1 Theory of the determinants of migration

A brief review of the main theories of the determinants of population mobility is important for illustrating the similarities found in the livelihoods and migration literatures. This is not meant to be a complete discussion of the theories of migration (these can be found in other comprehensive reviews- see Massey, 1993; Skeldon, 1990, DeJong and Gardner, 1981), but rather the aim here is to illustrate the commonalities between the two fields.

Early theories of the determinants of migration focused principally on rural-urban migration in developed countries. Initial theories focused on differential wage rates in urban and rural areas. Migration scholars theorized that wage differentials between rural and urban areas were determined by different factors of production (land, labor, and capital) between rural and urban areas. It was believed that wage differentials were ultimately related to differences in supply and demand of labor, which would lead to the departure of excess labor from rural areas to cities where demand for labor was high (Sjaastad, 1962). Furthermore, Sjaastad theorized migration to be an individual investment decision related to the potential for improved income minus the expected costs of moving (1962). The theory is based on microeconomic theories related to the individual rational actor and utility maximization. Todaro later suggested that decisions to move were based not just on wage differentials in origin and destination areas, but also on expected income differentials based on the probability of employment in the destination area (1969). Empirical studies based on these theories have tended to focus on the importance of individual human capital assets such as education and work experience, and additionally have assessed the importance of characteristics, such as age, sex, and marital status.

The new economics on labor migration theory (NELM) proposes that migration is a calculated strategy by households seeking to diversify income opportunities (Stark and Bloom, 1985; Taylor, 1999). Root and DeJong also argued for the conceptualization of a family-migration system in which households make decisions about the migration of individual members (1991). The NELM view of families as decision-making units suggests a rational calculation of the monetary costs and benefits of a member of the household migrating. An important linkage between the livelihoods concept and this theory is the idea of remittances serving as a means of stabilizing income through the diversification of sources (Ellis, 2000; Stark and Lucas, 1988). Empirical studies of migration and remittances have shown that cash transfers from migrants to origin households can be an important contribution to the origin household income (Stark, 1980; Stark and Lucas, 1988; Taylor, 1999).

Theoretical approaches to population mobility have not focused solely on individual and household determinants, but have also explicitly addressed the larger context in which migration decisions are made. Labor markets (Harris and Todaro, 1970; Lewis 1954) and regional environmental conditions (Gray 2009; Henry et al. 2004; Findley 1987) have been theorized to be important determinants of migration as well. Land scarcity has also frequently been hypothesized to be an important contributor to out-migration (Findley, 1987; Shaw 1974; VanWey, 2003; Wood, 1982).

Theories related to social networks and social institutions suggest that social relations may play an important role in initiating and perpetuating migration. These theories hypothesize that migrants will share information with members of the household and others about their move and the destination area (Carrington et al, 1996). This information is likely to increase the probability that other members of the household or the community will migrate. In addition,

migrants may provide financial and/or material support for other members of their household wishing to move, thus lowering the moving costs (Carringon et al, 1996). Empirical studies have observed that migrants usually maintain close social ties with their households in origin areas, and that these ties are important conduits for information about culture, technology, and the migration experience (Curran and Rivero-Fuentes, 2003; VanWey, 2004). It has also been theorized that institutions (social, private, and voluntary) develop to facilitate and perpetuate the migration stream (Massey, 1993).

Finally, political-economy theories on migration have viewed migration as a part of the structure of the capitalist system. The dual-market and world system theories focus on migration as a product of the disruptive forces of capitalism (Massey, 1993). The livelihoods framework because of its focus on smaller units of analysis does not directly address the ideas within these theories. It is important, nonetheless to contrast political-economist's negative view of migration with that of the livelihoods framework, which generally views migration as a positive strategy, intended to reduce risk (deHaan, 1999; Ellis, 2003; Ellis, 1998).

3.3.2 Definitions and concepts

One problem with migration within the livelihoods framework is that the definition is usually ambiguous, and the term "migration" is often used to refer to diverse types of mobility. This is in part due to the fact that population mobility is characterized by both spatial and temporal dimensions. Several authors have reviewed this problem and suggested different typologies and conceptualizations of migration (Bell et al. 2002; Bilsborrow et al, 1984; Skeldon, 1990).

The physical movement of people has been conceptualized most broadly as population mobility (Skeldon, 1990) or territorial mobility (Bilsborrow et al, 1984). Population mobility encompasses all spatial and temporal dimensions of movement and thus captures all of the diverse types of migration. The spatial dimension may range from a move across international boundaries to a residential change within a neighborhood or community. The temporal dimension may range from a permanent lifetime move (i.e., moving from your place of birth and never returning) to daily commuting for work. Internal migrants in developing countries (the focus of this research) can in general be grouped into three main categories: long-term migrants, temporary migrants, and transients. Each type of migrant can be further divided into sub-categories. Long-term migrants may be defined as those who change their place of residence and their activity space for long periods of time and may include: working-life migrants (those who move to a place for all of their working life with the intention of returning to their place of birth when they retire), lifetime migrants (those who leave their place of birth with no intention of ever returning), target migrants (those who move to attain a specific goal, usually to accumulate human or financial capital with the intention of then returning), and step migrants (those who make multiple moves before settling in a destination for a long amount of time) (Bilsborrow et al, 1984).

Temporary migrants may be defined as people who change their activity space for a period of time but do not change their place of residence. Temporary migrants may include: seasonal migrants (those who move regularly with the seasons to take advantage of opportunities in different areas- labor, education, or production activities), and compensatory migrants who move irregularly (those who move for labor or other income opportunities when the need or opportunity arises, but not with the regularity of seasonal migrants) (Standing, 1984).

Transients can be defined as those people who have no usual place of residence. This group can include nomadic people who either constantly move their place of residence within a very large activity space and wanderers who have neither a usual place of residence nor a regularly used activity space. While many Amazonian indigenous groups once lived nomadically or periodically moved their village settlement, a combination of factors, including pressure from missionaries, availability of services at fixed locations such as schools, airstrips, and radios, and smaller territory sizes have led to the current situation in which the majority of Amazonian indigenous people live in permanent settlements (Chagnon, 1997; Early and Peters, 1990; MacDonald, 1999; Ziegler-Otero, 2004).

A proper understanding of the role of migration in the livelihoods framework requires a more precise specification of where different types of migration fit within the livelihoods framework. I suggest that in the livelihoods framework, migration most often refers to long-term migration and the remittances that migrants send to origin households as a means of livelihood diversification. Temporary labor migration however, falls within the non-farm employment category of livelihood diversification, and in many cases may be difficult to distinguish from local non-farm employment. This distinction may be difficult because it relies upon the researcher to arbitrarily decide what distinguishes temporary labor migration from commuting for employment. As such, in this dissertation both of these types of employment (temporary labor migration and local employment) are included in the concept of livelihood diversification.

3.3.3 Conceptual links between migration and the livelihoods framework

Migration is consistently included as an important part of the livelihoods framework (deHaan, 1999; Ellis, 2003; Ellis, 2000; Ellis, 1998; Scoones, 1998). Migration theory and the

migration literature, however, have developed independently from the livelihoods framework. Several authors have discussed conceptual linkages between the two bodies of literature (deHaan, 1999; Ellis, 2003; Vanwey 2003), but there are few published empirical studies of migration that explicitly use the livelihoods framework (for exceptions, see DeHaan, 2002; Waddington, 2003; Vanwey, 2003).

The most common linkages made between the two bodies of literature relate to risk management. For example, Vanwey, in her study of the determinants of temporary migration in Thailand, integrates theories of livelihood diversification with those of temporary migration (2003). She suggests that theories of diversification are consistent with the NELM theory. Similar to the livelihoods framework, NELM considers population mobility to be one strategy in a set of risk diversification options available to rural households (Stark and Bloom 1985; Stark and Taylor 1989). This approach suggests that mobility decisions may be a way for households to accumulate resources for agricultural investment and to minimize risks to household subsistence.

The theory of multiphasic response also discusses the linkages between agricultural livelihoods, livelihood diversification, and migration (Bilsborrow 1987; Bilsborrow and Ogendo, 1992). In an assessment of household responses to population growth, Bilsborrow and Ogendo (1992) suggest four phases of response: changes in tenure arrangements, extensification, changes in technology (usually intensification of land use and adoption of new technologies), and demographic change (postponement of marriage, reduction of fertility, and out-migration. The authors suggest that tenure changes will usually happen first, but may happen concurrently with extensification and intensification, and that demographic change is likely the last response. Multiphasic response is an excellent discussion of the tradeoffs households face regarding

decisions about livelihoods and mobility. However, the idea of household "responses" implies that livelihood and mobility decisions are coping behaviors rather than proactive risk diversification strategies.

The idea of "pull" and "push" factors discussed in the migration literature (Lee, 1966) implies both household agency as well as behavioral response. Pull factors are thought of as positive conditions in areas of destination that attract people to move there, whereas push factors are thought of as events, conditions, or trends in areas of origin that stimulate individuals or a household to leave (Lee, 1966). The concept of risk diversification suggests that a household makes livelihood and migration decisions based on information available in the home community as well as in potential labor markets or migration destination areas. Conversely, coping behavior suggests that livelihood decisions and migration decisions are made principally as a result of conditions in the home community.

Additionally, both the migration literature and the livelihoods literature theorize about the importance of the labor market in determining decisions regarding livelihoods and mobility. The wage gap between urban and rural areas is theorized to result in rural-urban migration. Similarly, in terms of local employment, the difference between wages and returns from agriculture are thought to determine decision regarding participation in non-farm employment.

3.4 Challenges of adapting the livelihoods framework to Amazonian indigenous

The adaptation of the livelihoods framework to the indigenous context presents several challenges. First, the livelihoods concept has been developed principally in the context of households whose primary source of income and subsistence is agricultural production. As a result, the idea of farm production does not usually include natural resource based activities such

as hunting, fishing, and the gathering of non-timber forest products (NTFPs). Activities such as hunting, fishing, and the gathering of non-timber forest products are an important aspect of indigenous and forest peoples livelihoods (Byron and Arnold, 1999; Lu and Bilsborrow, 2010; Takasaki et al., 2004). Within the livelihoods framework NTFP activities are often aggregated together with wage and self-employment activities in the non-farm category despite being conceptually very different. Because I see these activities as being commonly a traditional aspect of indigenous livelihoods, I leave them out of the definition of non-farm employment and do not consider them as a form of livelihood diversification for indigenous peoples.

In the Amazon context, research examining the relationships between demographics, livelihoods, and the environment has focused principally on frontier colonists rather than long-established indigenous populations, and it is likely that indigenous livelihood decisions are not motivated by the same factors as colonist households (de Sherbinin et al., 2008). Indigenous communities are likely to have tighter kin networks and long established social networks, and risk, labor-requirements, and knowledge requirements for different livelihood activities may be shared more at the community-level or kin-group level than at the household level (de Sherbinin et al., 2008). As this research includes multiple ethnic groups, it will be important to include both ethnicity variables and institutional variables to control for ethno-cultural differences as well as institutional context.

3.5 Hypotheses

The modeling approach that is used in this dissertation allows for a multivariate comparison of different types of capital in relation to the outcomes of interest. I expect that the odds of participation in non-farm employment and out-migration will differ in relation to

household and community assets, social relations, and institutions. A list of the hypothesized associations is presented in Table 1. These hypotheses are principally based on the livelihoods and migration literature discussed above, and, more specifically, the theories related to labor market returns and risk mitigation.

Table 1. Hypothesized relationships between independent variables and outcomes

	Non-farm employment	Out-Migration
Human Capital Assets		
Education	Positive	Positive
Whether can speak Spanish	Positive	Positive
Number of adults	Positive	Positive
Number of children	Negative	Negative
Natural Capital Assets		
Cultivated area (log)	Negative	Negative
Communal reserve for hunting and gathering	Negative	Negative
Worse hunting	Positive	Positive
Worse fishing	Positive	Positive
Social Capital Assets		
In-kind exchanges	Negative	Negative
Previous out-migrant	Positive	Positive
Community social organization	Negative	Negative
Financial Capital Assets		
Household wealth	Negative	Negative
Use of credit	Negative	Negative
Number of cattle in 1990	Negative	Negative
Migrant remittances	Negative	----------
Physical Capital Assets		
Distance to road	Positive	Negative
Public transport	Negative	Negative
Production goods	Negative	Negative
Local businesses	Positive	Negative
Mediating Factors		
Social		
Age of head of household	Negative	Negative
Age of individual	----------	Curvilinear
Gender of head of household (female reference)	Positive ----------	Positive Positive
Gender of individual (female reference)	Negative	Negative
Years in community	Various	Various
Ethnicity of household	Positive	Negative

Population size of community	Positive	Positive
Population growth		
Accessibility	Negative	Negative
Travel time to market		
Institutions	Positive	Positive
Common property regime	Negative	Negative
NGO or Gov. agency assistance for agriculture		

In general, I expect that human capital assets will be positively correlated with participation in non-farm employment and out-migration. Higher levels of education should increase an individual's wage rate and thus increase the possible returns from non-farm employment and out-migration. Similarly, the ability to speak Spanish should improve a household's ability to interact with labor markets. I also expect that the number of adults in a household will be positively correlated with non-farm employment and out-migration since the marginal returns to agriculture are likely to decline as the number of adults increases. I expect that additional household labor will be allocated to different livelihood activities, specifically non-farm employment and out-migration as the number of adults increases. The number of children is expected to be negatively correlated with livelihood diversification and out-migration since there are likely to be higher labor demands in terms of both household subsistence and child rearing, which may preclude adult members from being absent from the household for extended periods for non-farm employment or out-migration. It is possible, however, that the higher consumption needs of having more children could increase livelihood diversification needs.

I expect that natural capital assets will be negatively correlated with non-farm employment and out-migration as these assets are directly related to the agricultural and other natural resource based livelihoods. Community-level characteristics such as the availability and

hunting, fishing, and forest product extraction areas are expected to increase participation in natural resource based livelihood activities and decrease participation in non-farm employment and the likelihood of out-migration. The condition of the hunting and fishing resources in these areas, however, is important, and worsening returns from hunting and fishing will likely result in shifts to agricultural livelihood activities, non-farm employment, as well as out-migration.

Prior investments in agricultural livelihoods are expected to be negatively correlated with non-farm employment and out-migration. Total cultivated area, which includes the area in annuals, perennials, and cattle pasture is an indication of the labor households have allocated to agriculture as well as the human capital investments households have made in learning new production techniques, and the financial capital investments required for purchasing seeds and plants, inputs (though the use of fertilizers and pesticides is almost non-existent), and cattle.

Social capital assets are expected to have variable effects on non-farm employment and out-migration. Intra-communal social interactions such as labor sharing, sharing of hunting catch, and community social organizations are likely to strengthen relationships between households and increase reciprocity. Reciprocity may decrease vulnerability and thus these types of social capital assets are expected to decrease the likelihood of participation in non-farm employment and out-migration as risk mitigation/coping livelihood strategies. On the other hand, some types of social capital assets such as links with out-migrants are hypothesized to facilitate out-migration by providing information about the migration experience and providing assistance with a move. Similarly, this type of information is expected to reduce the barriers to non-farm employment, and the limited remittances from migrants in this setting suggest that migration will not serve as a substitute for non-farm employment.

I expect financial capital to be negatively correlated to both non-farm employment and out-migration. As mentioned earlier, theory predicts wealthy households will be less risk averse, and open to new livelihood strategies. In the case of the indigenous, however, many agricultural production activities for the market are also likely to be new livelihood strategies. I expect that the wealthiest households will invest in agricultural livelihoods before considering non-farm employment or migration. I also expect that poor households view non-farm employment and out-migration as means of attaining capital for natural resource based livelihoods.

In the Amazon, and throughout Latin America, owning cattle is a means of saving. Thus cattle ownership should also be considered a measure of household wealth, and is expected to be negatively correlated with non-farm employment and out-migration. In the colonist context, credit is most often used for purchasing cattle and for other agricultural investments. I expect that similarly, in the indigenous context, using credit would stimulate investment in agricultural livelihoods like cattle rearing and cash cropping and, therefore, would negatively affect the likelihood of non-farm employment and out-migration. Similarly, remittances sent home by migrants might, like credit, be thought of as a source of financial capital for household investment. Again, I expect that these remittances will be invested in natural resource based activities rather than non-farm employment or out-migration, or will be used for consumption rather than invested in household livelihoods. In general, I expect that non-farm employment and out-migration will be the livelihood strategies most accessible to poor households since they require little financial capital. In addition, because the non-farm employment opportunities in this setting are low-skilled jobs, low levels of education among the poorest are unlikely to be a barrier to participation.

Most physical capital assets are expected to be negatively correlated with non-farm employment and out-migration. The distance to a road for example is likely to influence the types of livelihood activities that are chosen by households. On one hand, easy access to a road is likely to facilitate the transport of goods to markets, whereas being far from a road will likely serve as a barrier to selling agricultural and forest products and will lead to participation in other livelihoods. Conversely, easy road access may facilitate commuting to work places, and thus might have a positive relationship with non-farm employment. Because other access variables, such as travel time to market and the presence of local businesses, will be controlled for, the road access variable will effectively only measure the effect of road infrastructure, which is expected to have mixed effects on non-farm employment and out-migration. Similarly, public transport infrastructure, either in the form of a regularly scheduled bus, truck, or canoe is expected to facilitate agricultural production and thus be negatively associated with non-farm employment and out-migration.

Production goods are household and community goods that are used for livelihood activities. These items (e.g., a chainsaw, coffee peeler, sawmill, etc.) are likely to improve efficiencies and returns from agricultural and forest livelihoods. Thus, they are expected to be negatively correlated with non-farm employment and out-migration. The most important aspect of physical capital in terms of non-farm employment and migration is the presence of local businesses (oil companies, agricultural plantations, ecotourism agencies, etc.) that are located either in or near the communities, and provide employment opportunities. These businesses are expected to be positively correlated with non-farm employment but are expected to be negatively correlated with out-migration, since local opportunities to diversify livelihoods might deter the departure of individuals who otherwise might out-migrate to find employment.

The roles of individual, household, and community mediating factors are also assessed in the examination of non-farm employment and out-migration decisions. Social factors are expected to play an especially important role in mediating the relationship between different types of capital and the two outcomes. First, the age and gender of the head of household are likely to impact decisions regarding non-farm employment. The age of the head of household is expected to be negatively correlated with non-farm employment, as the life cycle of the household has been hypothesized to be related to agricultural livelihoods (Chayanov, 1966; Walker et al., 2002). Young households are not likely to be fully vested in agricultural livelihoods and may engage in non-farm employment as a means of generating capital for future livelihood activities. Female-headed households are expected to be less likely to engage in non-farm employment, since it is unlikely that female heads will be absent for extended periods. As a result, female-headed households are likely to have less experience interacting with labor markets, which will decrease the likelihood of participation by other adult members of the household.

In the examination of out-migration, age and gender are considered at the individual level rather than at the household level. The age of the individual is expected to have a curvilinear relationship with out-migration, as age is consistently associated with migration, and individuals at the youngest ages (15-18) and older ages (40+) are expected to be less likely to out-migrate. Women are expected to be less likely to out-migrate if migration for marriage is not considered in the models. While female migration to urban areas was found to be an important aspect of mobility among the colonist population in the study area (Barbieri et al., 2009; Barbieri, 2005), indigenous women are expected to have less freedom regarding mobility decisions, and to be less likely to permanently leave their households than men.

Recently, studies in the Ecuadorian and Brazilian Amazon have found that farm cycles are an important determinant of land use independent of life cycle (Barbieri et al., 200; VanWey et al., 2007). A household will clear forest area early in a property's life and will depend on annual crops in early years as perennials crops mature. Based on the idea of non-farm employment and out-migration as means of generating cash for investment in agriculture, I expect that recently established households would be more likely to engage in these activities.

Ethnicity is expected to play a very important role in determining livelihood activities and I expect a variety of differences among the ethnic groups in terms of participation in non-farm employment and out-migration. The household ethnicity variable will capture both cultural and historical effects that aren't controlled for by other variables in the models. As such, creating hypotheses regarding ethnicity is not easy. In general, however, I expect there will be a spectrum of participation in non-farm employment based on cultural preferences for different types of livelihoods and based on past experience with different livelihoods. I expect this spectrum to range from the Secoya and Shuar on the low end of engagement in non-farm employment, to the Huaorani at the high end, with the Cofán and Kichwa falling in between. In terms of out-migration, I expect a slightly different spectrum with the Secoya at the low end of mobility, since there are very few other Secoya communities for them to migrate to, because they tend to be heavily vested in local natural resource based livelihoods, and because they have few land constraints due to large community reserves. In contrast, the Shuar are likely to be at the high end of the spectrum, as Shuar communities do not establish community reserves and out-migration by males in order to establish new Shuar communities appears to be something of a rite of passage (Rubenstein, 2001; Rudel et al., 2002). The Huaorani are also expected to be on

the high end of the spectrum of out-migration due to their semi-nomadic history. Finally, the Quichua and Cofán are expected to have intermediate levels of out-migration.

Many community-level factors are also expected to mediate the relationships between the different types of capital and livelihood diversification. Community-level demographic factors that may play a role include population size, population growth, and population density. The population size of a community is expected to be positively associated with non-farm employment, because in larger communities households will have to travel further to agricultural plots and compete with each other for forest resources, thus stimulating diversification into new livelihoods. Population size is expected to be negatively associated with out-migration, because larger communities are more likely to attract residents to stay and there may be greater livelihood diversification opportunities. Perhaps more important than population size, is population density, since density gives an indication of land constraints in the community. Unfortunately data on population density could not be created. Data on population growth may give some indication of changes in land availability, though it will not specifically measure land constraints. Population growth is expected to have a similar relationship with livelihood diversification, since households in rapidly growing communities may perceive changes in the availability and access to land.

Other community-level mediating factors that will be examined include accessibility and institutional context. Accessibility is expected to be an important contributor to livelihood decisions. The time that households must travel to markets, the places where they would likely sell agricultural and forest products, and where they would purchase consumer goods, is expected to be negatively correlated with non-farm employment and out-migration.

Community institutions are expected to play an important role in local livelihood decisions. DeSherbinin et al. (2008) noted that among indigenous populations, the most important factors affecting livelihood decisions may be ethno-social and institutional contexts. Since indigenous lands in the Amazon are owned collectively, the resources therein may be managed through combinations of local formal rules and informal norms, often referred to as common property institutions. Common property institutions involve a structured ownership arrangement within which resource users develop management rules, and incentives and sanctions work to ensure compliance (Feeny et al, 1998; Ostrom and Schlager 1996; Runge, 1986; Schlager and Ostrom, 1992). The diverse common property institutions functioning among indigenous populations of the Ecuadorian Amazon can be loosely grouped into individual and communal arrangements (Bremner and Lu 2007). Tenure security, in general, has been hypothesized to be important factor in land use decisions (Angelsen and Kaimowitz, 1999; Bilsborrow and Ogendo 1992; Fearnside, 1993;). Therefore, is expected that communal arrangements will be positively correlated with non-farm employment and out-migration in comparison with individual arrangements, since perceptions of individual ownership are more likely to lead to capital investments in agricultural and forest based livelihoods.

External assistance from governmental and non-governmental institutions is also expected to impact livelihood decisions. Technical assistance and material support from these organizations may serve as substitutes for financial and physical capital for agricultural and forest based livelihoods. Thus, households in communities receiving assistance are expected to be less likely to engage in non-farm employment and out-migration.

Chapter 4

Research setting and data collection

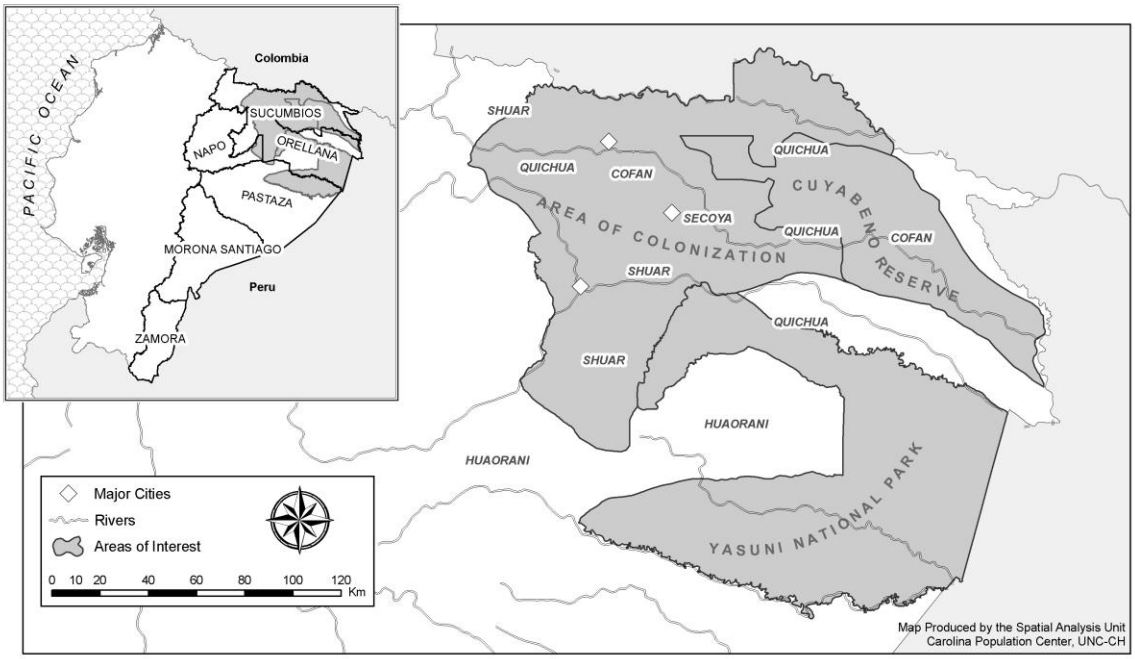
4.1 Introduction

This section is structured in three parts. The first section describes the research setting of the Northern Ecuadorian Amazon, discussing the history of colonization, the treatment of indigenous populations, and the impact on forest ecosystems. The second section more specifically describes the five ethnic groups that make up the study population of the NEA. The third part describes the sampling and methods used to collect data.

4.2 Research setting- Northern Ecuadorian Amazon

Ecuador can be divided into three distinct regions: the coast, highlands, and the Amazon (Figure 2). The eastern portion of Ecuador is part of the Amazon Wilderness Area (Mittermeiter, 2003), and is often referred to as the "Oriente". The area is characterized by lowland humid tropical rainforest with elevations between 200-500 meters. The climate is hot and humid with a high annual rainfall. The dry and wet seasons are not nearly as pronounced in the Ecuadorian Amazon, as they are to the east in Brazil, which affects cultivation strategies. Slash and burn cultivation dominates the Brazilian Amazon, while in Ecuador, the principle strategy has been slash and mulch, in which forested lands are cleared and unusable vegetation is left on the plot to decompose.

Figure 2. Map of the study area showing locations of different indigenous populations.



Prior to the 1960's, the Ecuadorian Amazon remained an isolated region with only one poor dirt road connection to the densely populated highland and coastal regions. In the 1930's initial explorations for oil in the province of Pastaza, by Shell, were unsuccessful. In 1967, however, a joint Texaco and Gulf consortium discovered large oil reserves in the Napo Province of the North Ecuadorian Amazon, and later in the Sucumbios Province (Figure 2). Rapid investment in a road network, oil production capacity, and the construction of an oil pipeline to transport oil across the Andes to the Pacific followed during the 1970s (Sabin, 1998; Wunder, 2003). Oil has been the dominant export commodity of the country since 1972, and 99% of the oil comes from the Northern Amazon (Wunder, 2003).

The period of rapid oil expansion also coincided with a call for land reform policies in the highlands of Ecuador, which began in 1966. Severe land inequality combined with rapid

population growth in the highlands led to land scarcity for rural farmers and land reform policies were advocated as an alleviation strategy. In order to avoid controversial land redistribution in the highlands, however, the Ecuadorian government chose instead to promote agricultural settlement in the Amazon lowlands. The combination of new roads built by oil companies and land-titling policies that promoted colonization facilitated rapid migration of agriculturalists from the highlands (Pichón 1992; Walsh et al. 2002). This colonization has often been referred to as spontaneous, since decisions to migrate to the Amazon were made by individuals and households, and thus were not part of a government planned settlement project, as in Brazil where houses and schools were built and families were financially rewarded for relocating to the Amazon. This term spontaneous, however, belies the political environment during the early 1970's, at which time Amazon colonization was promoted as a means of reducing land pressure and socio-economic imbalances in the densely populated highland and coastal regions (Pichón, 1992).

During the boom period of the 1970's and 1980's the indigenous populations that had traditionally inhabited the region repeatedly clashed with colonists and other institutions over land rights. The 1964 Law of Fallow Lands classified large portions of the Amazon as "unoccupied lands", despite the fact that they were occupied and used by indigenous populations. The law allowed colonists to claim 50 hectare plots of "unoccupied land" along roads and also promoted deforestation by requiring proof of "improvements" (in the form of land clearing) in order to establish legal land title.

There were no specific laws protecting the land and resource rights of indigenous peoples during the period of rapid colonization. Conflicts over land rights led to the creation and mobilization of regional indigenous organizations as well as ethnic sub-federations (Martin,

2003). In the midst of varying levels of encroachment by settlers and oil companies, the mechanisms the federations used or promoted to secure land rights varied both inter- and intra-ethnically. Many communities worked with their federations and through the government land-titling agency to legalize communally titled territories of varying sizes, but usually containing a single settlement or community center. The result appears to be a somewhat haphazard mosaic of indigenous community territories, many along rivers, intermixed with colonist settlements along roads. In some cases, groups of Shuar from the Southern Amazon and some Kichwa have taken advantage of the titling policies to themselves colonize "new areas", which has resulted in intermittent conflicts between indigenous groups. In contrast, the Huaorani, the most isolated of the ethnic groups, have gained rights to large "Huaorani territories" that contain multiple settlements. In these large territories, the borders of individual communities are not well defined, but the borders of the larger Huaorani territory are fiercely defended either through violence or threats of violence (personal observation). A final means of protection was created in 1999, when the Ecuadorian government declared several large Huaorani areas in Eastern Pastaza as "zonas intocables" (untouchable areas) that would be protected in perpetuity from all extractive activities. While these lands are legally owned by the state, the existing indigenous communities maintain rights of use, although with some restrictions regarding hunting, timber, and oil extraction.

The total population of Ecuador recorded in the 2001 census was 12.1 million inhabitants (INEC, 2001). The majority live in the coastal and highland regions, and the Amazon is still relatively sparsely populated in comparison. The 2001 population of the Amazon was 548,000, which represents a little less than 5% of the total population of the country. The annual

population growth rate for the Amazon, however, was approximately 3.2%, which is far higher than the national growth rate of 2.1% annually (INEC, 2001).

The population growth of the Amazon has been principally due to the colonization discussed above. Results from the 1990 census showed that over 44% of the population was born outside of the Amazon (INEC, 1991). In addition to in-migration, the Amazon region of Ecuador has the highest total fertility rate of the country (4.2 births for the Amazon vs. 3.3 for Ecuador) (CEPAR, 2004) and fertility rates are much higher in rural areas of the Amazon (Carr et al., 2006) and among indigenous populations (8.3 births) (Bremner et al., 2008).

The colonization of the NEA and growth of agricultural production have led to the creation of several urban areas. The largest Ecuadorian Amazon city, Lago Agrio (legally called Nueva Loja), is located in the study area, and has a population of approximately 34,000 inhabitants (INEC, 2001). There are several other smaller urban centers in the study area that provide important services for the study population, including Francisco de Orellana or Coca (18,000), La Joya de los Sachas (6,000), Shushufindi (11,000), Puyo (24,000), and Tena (16,000). In 2001, two thirds of the Northern Amazon population still lived in rural areas (Table 2), but the trend is towards an increasingly urban population (INEC, 2001).

Table 2. Population distribution of the NEA by province in 2001.

	Urban	Rural	Total	Urban (%)
Sucumbios	50198	78797	128995	38.9
Napo	25759	53380	79139	32.5
Orellana	26191	60302	86493	30.3
Pastaza	26892	34887	61779	43.5
NEA Area	129040	227366	356406	36.2

Smallholder agriculture and cattle ranching are the dominant livelihood strategies of the colonists of the NEA. These activities have been the principle direct drivers of the rapid deforestation that has occurred since the 1970's (Southgate, 1990). Since 1990, the dominant trend in rural agriculture has been the rapid sub-division of landholdings into smaller plots, which contrasts greatly with the Brazilian trend of land consolidation and mechanized agriculture (Barbieri, 2005; Bilsborrow et al, 2005). The history of road building, spontaneous colonization, and land clearing for agriculture and cattle ranching contributed to the highest rate of deforestation in the Amazon (FAO, 2010).

Table 3: Deforestation estimates for South America 1990-2010 (FAO, 2010).

	Annual change					
	1990-2000		2000-2005		2005-2010	
Country	1000 ha/yr	Rate(%)	1000 ha/yr	Rate(%)	1000 ha/yr	Rate(%)
Brazil	-2890	-0.51	-3090	-0.57	-2194	-0.42
Chile	57	0.37	42	0.26	38	0.23
Colombia	-101	-0.16	-101	-0.16	-101	-0.17
Ecuador	-198	-1.53	-198	-1.73	-198	-1.89
French Guiana	-7	-0.09	-4	-0.04	-4	-0.04
Guyana	0	0	0	0	0	0
Paraguay	-179	-0.88	-179	-0.94	-179	-0.99
Peru	-94	-0.14	-94	-0.14	-150	-0.22
Suriname	0	0	0	0	-4	-0.02
Uruguay	49	4.38	22	1.48	45	2.79
Venezuela	-288	-0.57	-288	-0.59	-288	-0.61
South America	-4213	-0.45	-4413	-0.49	-3581	-0.41

4.3 The study population

The target population of this study is the indigenous peoples of the NEA, living in rural areas in 2001. In general, the target population is organized into households, in which individuals of a single-family unit share a dwelling. The household may also contain members of the extended family, and occasionally there are two family units living in the same dwelling.

Indigenous households are organized into communities, which generally consist of a concentration of dwellings in a village center. Agricultural plots, referred to as chacras, usually surround a small community center in various directions and distances, often several hours' away, depending on the geophysical characteristics of the land and the means of transportation available. In contrast, colonist landholdings are generally spread out along roads, and households live on their agricultural plots, called fincas.

The total indigenous population of the NEA is slightly greater than 100,000 inhabitants, approximately 30% of the total population of the area (Table 4) (INEC, 2001). The five groups chosen for the study, the Kichwa, Shuar, Cofán, Secoya, and Huaorani, vary substantially in terms of linguistic affiliation, history of contact, and integration into the market economy (Lu, 2007), but all depend to some degree on shifting agriculture and non-farm employment as key component of their livelihoods (Gray et al., 2008).

Table 4. Indigenous populations of the NEA by province in 2001.

Province	Indigenous Population	Total Population	Percent Indigenous
Napo	43456	79139	54.9
Orellana	26249	86493	30.4
Pastaza	22844	61779	37.0
Sucumbios	13476	128995	10.5
Study Area	106025	356406	29.7

The lowland Kichwa are the largest group in the NEA with an estimated population of 60,000 (INEC, 2001). Their population is widely dispersed, and many communities are near towns with schools and markets, while others are spread out along the length of the Rio Napo to the border with Peru. The Kichwa practice mixed livelihood strategies that involve both market activities and subsistence practices.

The Shuar are the largest group in the southern Ecuadorian Amazon with an estimated population of 45,000 (INEC, 2001). There are also now several Shuar communities in the NEA study area who have migrated from the southern Amazon, and their population in the study area may be as large as 3000 (INEC, 2001). In the Southern Amazon, the Shuar reorganized themselves in response to encroachment by colonists and have been highly successful in gaining legal title to vast areas of the province of Morona Santiago, where they have secured access to 40% of arable lands (Rudel et al., 2002b). Shuar communities have claimed land using similar legal mechanisms as colonists. As such, most Shuar communities are along roads and Shuar livelihood activities are highly market-oriented, including commercial agriculture, cattle, and employment with oil companies (Rudel et al. 2002b).

The Cofán have a population estimated to be fewer than 1,000 and occupy just a small portion of their ancestral lands, which included Amazon regions of Northern Ecuador and Southern Colombia. The Cofán are now limited to just seven communities. The largest Cofán community, Dureno, is close to a road and not far from Lago Agrio. In the early 1980s a group of Cofán sought to distance themselves from the encroachment pressures of colonists and oil companies and chose to move to a remote settlement that is now within the Cuyabeno Faunistic Reserve (Borman, 1999). The Cofán in the Cuyabeno still practice hunting, fishing and small scale subsistence agriculture, while the Cofán of communities close to Lago Agrio have incorporated cash crops, employment, and commerce into their livelihoods.

The Secoya also have a population estimated to be fewer than 1,000 and have experienced heavy pressure on their lands from colonists, agribusinesses[4], and petroleum companies. The Secoya traditionally inhabited the area that is now split by the Ecuador/ Peru

[4] Principally palm oil plantations in the areas surrounding Shushufindi.

border. Border wars between Ecuador and Peru forced the Secoya to flee west where they now are settled in just three communities in the Ecuadorian Amazon. There are also Secoya in the neighboring Peruvian Amazon who fled east during the wars. The Secoya in Ecuador have been the recipients of several development projects in recent decades, which has influenced several aspects of their culture and livelihoods (Vickers, 1994). Cattle ranching and credit programs, for example, were introduced through a development project over a decade ago, and, as a result, market based activities continue to dominate their livelihood strategies today.

Finally, the Huaorani have a population of approximately 2500 and occupy approximately one third of their traditional territory. This group was the last to be contacted by missionaries in the 1950s due to their reputation as fierce and violent warriors. While the Huaorani were traditionally semi-nomadic people who lived in dispersed kin groups, the influence of missionaries, who promoted schooling and built airstrips, led to larger permanent settlements that have now existed for several decades (Rival, 2002). While the Huaorani still depend largely on subsistence hunting, fishing, gathering, and small-scale agriculture, they also now interact regularly with markets and urban centers. In addition, Huaorani males are very active in oil company employment, which has become an important source of cash income for many Huaorani households (Bremner et al, 2005).

All five groups depend on some form of shifting agriculture as a key component of their livelihoods, along with hunting, gathering, fishing, and non-farm employment. Households typically cultivate several small, non-adjacent plots, in forest clearings, which may be part of a larger area to which they have usufruct rights and/or a larger community area managed under a common property regime (Gray et al, 2008). Legally, lands in all indigenous communities in the region are communally held or owned by the state, and only in a few communities can land

transactions, apart from inheritance, take place with approval of the community assembly (Bremner and Lu, 2006). Cassava, bananas and corn are the subsistence staples, a portion of which may be sold at market. Coffee and secondarily cacao are the main cash crops, though the attractiveness of coffee has declined with the market price over the last decade. Raising cattle is also an important form of commercial agriculture in the region, and has been adopted by some indigenous households. With the exception of the Secoya, however, households generally own only a small number of cattle, if any, possibly due to transportation and credit constraints. Secoya households have tended to have larger numbers of cattle in large part due to a development projects and technical assistance they received in the 80s and 90s.

Hunting is typically performed with shotguns for subsistence, though blowguns and other implements are still used in some communities and game is occasionally sold. Non-farm employment occurs most commonly with oil companies working in or near indigenous territories, but some self-employment in small commerce or handcraft production is also common. Other livelihood strategies include the raising of small animals (i.e. chickens, pigs and fish), participation in tourism, and the sale of timber and other forest products. Formal markets for land and credit are almost nonexistent in these communities.

4.4 Data collection and sampling

I use data collected in a study funded by the National Institutes of Health coordinated by Bilsborrow and Lu of the Carolina Population Center at the University of North Carolina at Chapel Hill. The study was conducted in the four northernmost provinces of the Ecuadorian Amazon covering the five largest indigenous groups the Kichwa, Shuar, Huaorani, Cofán, and

Secoya. The data collection in 2001 involved two phases of fieldwork: first, an ethnographic study in eight communities, and second, a household and community survey in 36 communities.

4.4.1 Ethnographic study

For the ethnographic study, ethnographers were trained for two weeks and then assigned to live in pairs (a man and woman) in each of the eight communities for five months. For this first phase, communities of all five ethnicities were selected based on their location, population size, familiarity to the research team based on personal visits, and willingness to participate. Both quantitative and qualitative data were collected from households and community leaders on a wide range of subjects, including: demographic behavior, agricultural production, time allocation, household economics, and socioeconomic attitudes and values. Methods used included participant observation, structured interviews, spot-check time allocation, post-hunt interviews, input-output household diaries, and life history interviews. The ethnographic data collection preceded the survey collection phase of the project and provided insights into people's decisions concerning reproduction, migration, land tenure and use, agriculture, governance and participation in the market economy, all of which helped inform the survey questionnaire design and interpretation of the subsequent findings.

4.4.2 Survey sampling

The survey data were collected from communities and households following a two-stage sampling procedure. Controlled sampling (Kish, 1965) was used to select communities to ensure adequate representation of the five largest ethnicities of the region and included a heterogeneity of location (accessibility), infrastructure, population size, and province, while also taking into

account the great difference in the numbers of communities of different ethnicities. The number of communities of each ethnic group was chosen to be roughly proportional to population size, except that in the two smallest groups (Cofán and Secoya) most of their communities were selected. Therefore, Kichwa and Shuar communities comprise over half of the sample since they are the largest indigenous populations in the study area.

Rather than sample all households in each chosen community, a maximum of 20 households per community was interviewed to reduce wide variations in sample size by ethnicity or community since the number of households in a community varies from 5 to over 50. Allowing for a possible 10% refusal rate, this meant selecting a sample of 22 households in the larger communities. Consequently, households in the 36 selected communities were sampled according to two rules. In the ten larger communities, 22 households per community were randomly sampled based on a sampling frame (a map of the community) prepared by the field supervisor and community leaders together showing the location of each occupied dwelling. In all the other communities (26), which had at most 22 households, all households were included in the sample. The final sample consisted of 564 households. Response rates for the survey were approximately 90% and resulted in complete data for 498 households, which is high considering indigenous communities often resist research efforts.

Due to the fact that different selection procedures were used for large and small communities, the probability of participation in the study was higher for households from small communities than for households from large communities. In order to correct for this bias, weights were calculated based on the proportion of households from each community that participated in the survey. These weights correct for the over-representation of households from small communities and are used for all descriptive analysis and modeling in subsequent chapters.

4.4.3 Survey data collection

Interviews were conducted separately with the male and female heads of each household by male and female interviewers, respectively. A female head of household is defined as either the woman in a female-headed household or the spouse of a male head of household. The questionnaires used for data collection are similar to instruments used for research conducted by Bilsborrow with colonists in the general study area in 1990 and 1999. Thus the household head's questionnaire covered household location, origin and migration history of head of household, land tenure and use, production and sale of crops, any raising of cattle or other large animals, employment, hunting and fishing, technical assistance and credit, perceptions of environmental contamination, and attitudes and aspirations for children's education and permanence in the community. Besides covering the same topics in connection with migration origins, the environment and aspirations, the spouse's questionnaire included a household roster that collected basic data for all members of the household, and spouse modules collected information on out-migration from the household, household assets, fertility, mortality and health. If either the female or male head of household was absent due to death, divorce, or migration, both questionnaires were implemented with the person available to ensure complete data collection for each household.

The most relevant modules of the questionnaire for this dissertation were the household roster, out-migration roster, and the employment section. The household roster collected demographic information for all individuals currently living in the household, including: gender, relationship with the head of household, age, place of birth, year of arrival in the community, level of education, language knowledge, and marital status. The out-migration roster collected information on anyone who had lived in the household and had left the community between 1990

and 2001 for at least six months and had not returned. The following information was collected for these individuals: gender, relationship with the head, year of migration, age at the moment of migration, marital status at the moment of migration, level of education at the moment of migration, economic activity at the moment of migration, reason for migrating, current economic activity, assistance sent to the migrant during the last 12 months, remittances received from the migrant in the last 12 months, and current place of residence.

The employment section collected information for each individual who had worked in wage labor or self-employment during the prior 12 months. Information was collected not only for each individual who had worked, but also for each type of work that an individual had performed. Consequently individuals may contribute multiple observations of employment if they participated in multiple types of work (i.e., working for an oil company and working for a tourism company). The information collected included: who worked, age, gender, employer, how many months or days they worked, where the work was located, how much they received in wages, and the wage rate.

Additionally, a community-level survey was implemented with leaders in each community. The community questionnaire covered a variety of topics, including: land title history, hunting and fishing resources, population (number of households as well as in- and out-migration), community infrastructure, location and access to external facilities (markets, health centers, secondary schools, etc.), contact with other communities, and contact with outside organizations and individuals.

4.4.4 Spatial data

In addition to survey data, spatial data were collected for both households and communities. Global Positioning System (GPS) coordinates were collected for three purposes: (1) to identify the geographic location of indigenous dwellings and agricultural plots; (2) to identify the location of roads, markets, schools, and other key community and regional infrastructure; and (3) to validate land use and land cover classifications by comparing land use on the ground with Landsat TM satellite imagery. A Geographic Information System (GIS) was used to create spatial variables related to distance and travel time. A 30-year time series of satellite imagery from 1973-2002 has been collected for the study region, but is not used in this dissertation research.

CHAPTER 5

Methods

5.1 Introduction

This chapter is divided into four sections. In the first, I discuss the data processing that followed the household and community survey data collection. The second section focuses on the methods, data structure, and models that are used for the study of livelihood diversification, and the third section describes the methods, data structure, and models used for the study of out-migration. The final section describes several limitations related to data availability, data structure, and the statistical methodology.

5.2 Data processing

The male questionnaire, female questionnaire and community data were entered into three separate databases by Ecuador project staff upon completion of the survey fieldwork. Graduate students associated with the Ecuador research project, including myself, conducted further cleaning of the data. Data were checked for entry errors, exceptional values, and errors related to consistency within the questionnaire. After the first pass of cleaning, the data for the male and female heads of household were merged into a single database using unique identifiers. Consequently, each observation in the primary dataset relates to a single household with data from the male and female heads of household. Within each household observation, there are data on each individual listed on the household roster. As mentioned earlier, in a few households

there are two nuclear family units living in the same dwelling. In these cases, the family units and individuals are still considered part of a single household observation.

Data from the community database were also merged with the household database based on unique community identifiers. As such, each household is linked to one of the 36 communities found in the community dataset. In the study of colonists, linking of colonists to communities was difficult because households lived on their farms and decisions had to be made by researchers regarding which community to associate households with (Pan et al, 2004). No difficulties were encountered in linking households to communities in this study of indigenous populations since community boundaries do not overlap, and households very clearly belong to one community or another. The final product of these database merges is a main dataset in which each of 496 observations is a household that contains individual, household, and community-level data.

5.3 Methods for the study of livelihood diversification

Binomial logit models are typically used to study phenomena with categorical outcomes (1 or 0), and thus, may be used to model the decision to incorporate non-farm employment into the livelihood activities of the household. The multi-level data structure of households nested within communities is appropriate for the study of livelihood diversification, since, as discussed earlier, decisions to diversify are conceptualized as being made at the household level based on the household's platform of assets and mediated by household and community-level factors.

Early multi-level models incorporated information from multiple levels but failed to account for the correlation of clustered observations. Statistical research has shown that models that fail to account for clustering of observations will produce unbiased parameters estimates,

and that standard errors will be underestimated (Bryk and Raudenbush, 1992; Goldstein, 1995). Underestimation of standard errors will lead to a greater probability of rejecting the null hypothesis (parameter estimate = 0) and thus the possibility of overstating results.

A more appropriate method of accounting for clustering is to account for the correlation in the covariance matrix. One method of correcting the covariance matrix is to use procedures developed by Huber (1967) and White (1982) to attain robust standard errors. This procedure has been shown to calculate both unbiased estimates as well as larger standard errors, thus decreasing the probability of incorrectly rejecting the null hypothesis. Another method is to use hierarchical models or multi-level models in which the random effects can be specified (Goldstein, 1995). For this research both methods were examined, and ultimately a multi-level model approach was selected.

5.3.1 Model of non-farm employment

For the study of non-farm employment, a random effect binomial logistic regression model was estimated using the Generalized Linear Latent and Mixed Models (GLLAMM) program within STATA I/C12 using adaptive quadrature estimation (Rabe-Hesketh et al, 2005). This model is appropriate for categorical outcomes and accounts for clustering and contextual effects at the community-level. In this model a two-level random intercept model is estimated with the outcome coded as 0 for no household participation in non-farm employment in the last 12 months, and 1 for household participation in non-farm employment. The model equation has the following form:

$$\text{Log}\{p_{ij} / (1 - p_{ij})\} = B_0 + B_k X_{ik} + \lambda_l Z_j + e_j \qquad \text{(NFE Equation 1)}$$

Where:

p_{ij} is the odds that household i in community j participates in non-farm employment;

$(1 - p_{ij})$ is the probability that a household does not participate;

i is an index 1, 2,…M_i of households in community j;

j is an index 1,2,…J of communities in the study area;

B_0 is a constant;

B_k is a vector of parameters for effects of independent household variables K;

X_{ik} is a vector of household-level independent variables for i households;

λ_l is a vector of parameters for the effects of independent community variables L;

Zj is a vector of community-level independent variables;

e_j is a community-level random effect.

The regression coefficients (β) are exponentiated (e^{β}) to created odds ratios, which are interpreted as the multiplicative effect of a one unit increase in the independent variable on the odds of participation in non-farm employment. The inclusion of the community-level random effect accounts for unobserved characteristics at the community level not correlated with the observed community characteristics Zj.

5.3.2 Dependent variable

The dependent variable categorizes households according to participation or non-participation in non-farm employment during the 12 months prior to the survey. The creation of this variable required some decisions regarding what should qualify and what should not qualify as non-farm employment. All types of wage employment, regardless of the type of work and the sector, are treated as a form of livelihood diversification and are categorized as non-farm employment. Self-employment that involves the sale of non-natural resource based activities

such as store ownership or other businesses are also categorized as non-farm employment. Self-employment, however, that is natural resource based such as handcrafts production and personal timber sales are not categorized as non-farm employment for this analysis, as they are difficult to distinguish from other natural resource based livelihoods, which are discussed in more detail in chapter 6.

Non-farm employment can also have multiple spatial and temporal dimensions, including working in the community, working in a nearby area but returning to the community each night, or temporarily migrating elsewhere for work. These dimensions, while important, should not be addressed through multivariate analysis at the household level, since many households have had multiple non-farm employment sources with varying characteristics during the year. Spatial dimensions of employment are explored to some degree in the descriptive analysis but could be explored further in future analysis exploring individual determinants in addition to household and community determinants.

5.3.3 Household independent variables

The variables in the model aim to capture various types of assets available to the household in relation to the livelihood conceptual framework's platform of household assets, which includes human capital, natural capital, physical capital, financial capital, and social capital. At the household level, human capital variables include education, household composition (because number of adults may be indicative of household labor supply), and Spanish language ability of the head of household. Natural capital variables include total cultivated area. Social capital variables include whether the household engages in-kind labor exchanges, whether the household participates in communal work days called mingas, and

whether a member of the household has out-migrated from the community, thus providing information about new or different labor opportunities. Financial capital variables include use of credit[5], a count of assets (not related to production) that the household had five-years prior to the survey, migrant remittances received in the last 12 months, and savings in livestock (# of cattle in 1990). Finally, physical capital variables include productive goods that the household uses to support their natural resource based livelihood.

Some types of assets are not held by households but rather are available at the community level. Community-level natural capital variables include the presence of a river for fishing and the presence of a communal forest area for hunting and gathering of forest products. In addition, two community-level variables measuring the quality of the hunting and fishing resources were included. Social capital includes the number of community organizations that bring community members together for meetings or other collective functions, thus creating more social connections among households. Community-level physical capital variables include presence of a road, number of community productive assets (e.g., a coffee peeler or saw mill), presence of regular public transport, and presence of a community non-farm business.

Several household and community-level mediating variables are expected to modify access to capital, including: the age, ethnicity, gender, and residence time of the head of household, the existence of a formal community resource management institution, the presence of government and non-government agricultural assistance agencies, the community population size and growth rate, and finally, the accessibility of markets and cities.

[5] Credit is not considered to be endogenous to participation in non-farm activities since in this context the majority of loans were used for farm investment.

5.3.4 Operational framework for livelihood diversification and out-migration

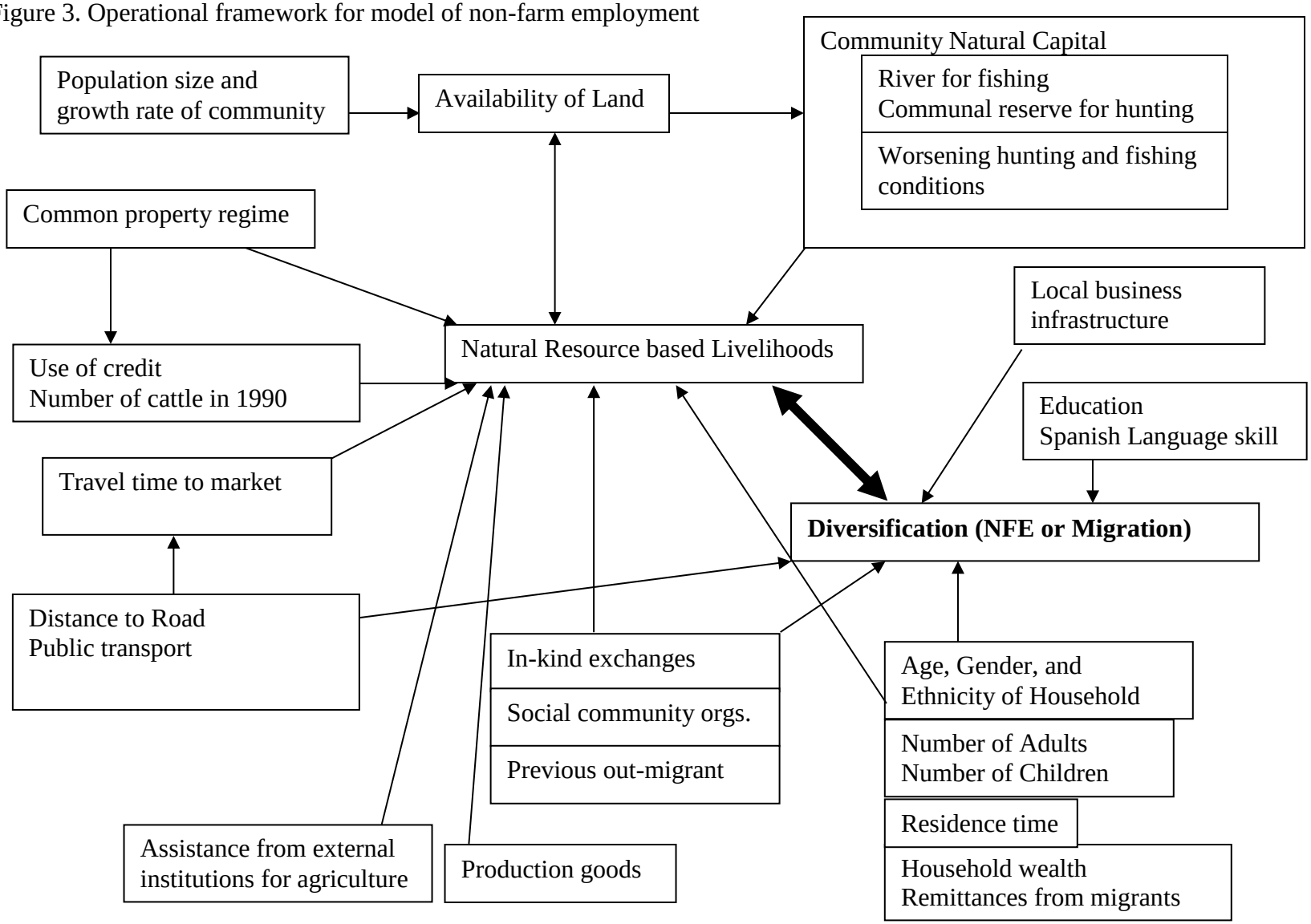
Figure 3 presents an operational conceptual framework used for developing models of non-farm employment and out-migration. In line with the theory of livelihood diversification, the household is thought to be making choices among various livelihood strategies based on available household-level and community-level human, social, financial, and physical capital assets. Indigenous households livelihoods are conceived as being natural-resource based, depending on a diverse mix of agriculture, hunting, fishing, and timber and non-timber forest product collection. Decisions regarding whether to participate in non-farm employment, how much time to allocate to non-farm employment, or whether to have a household member permanently out migrate from the community, are conceived as being related to both the ability of the household to construct a natural resource-based livelihood, the ease of access to non-farm employment opportunities, and the household's human, social, and physical capital assets that would aid them in accessing and acquiring non-farm employment or out-migrating from the community.

The figure illustrates that many of the independent variables included in the models (e.g. land and labor availability, market access, and many other factors) are hypothesized to affect the ability of households to sustain a natural resource-based livelihood, which in turn affects the households' decisions to diversify their livelihood through non-farm employment or out-migration. Several independent factors, however, are hypothesized to directly affect household decisions regarding non-farm employment, particularly the ease of access to work opportunities as well as individual and household human capital.

While the operational framework is helpful for developing hypotheses for this research, it also presents some challenges. The framework suggests that there may be tradeoffs that occur

between non-farm employment, migration, and natural resource-based livelihoods, and as such there is the possibility of endogeneity, particularly in terms of agriculture. Time or labor allocated to non-farm employment is time not spent working the chacras, and out-migration of adult members of the household results in fewer hands available for agricultural labor. In fact, prior research on the predictive factors of the total cultivated area of the indigenous households, indicates that participation in non-farm employment is significantly associated with less cultivated area, though the number of migrants from the household was not significant (Gray et al., 2008). Because the data for agricultural land use and non-farm employment for this research are cross-sectional endogeneity is a challenge that must be assessed carefully in the construction of the independent variables and several efforts are made to develop independent variables based on retrospective questions in the survey.

Figure 3. Operational framework for model of non-farm employment



5.3.5 Variable construction

The specification of several of the variables discussed above is straightforward based on the data collected. In several cases, however, variables must be created from available information. The following section explains the variable construction for community-level and household-level and individual-level independent variables that are used both in models of non-farm employment and out-migration.

A common variable included in analysis of livelihood diversification is the presence of land constraints on agricultural extensification. Because the boundaries of the indigenous communities were difficult to identify, the total area of each community could not be measured. In addition, without total land area, population density, which might indicate land constraints, cannot not be calculated. Instead two community demographic variables that are indicators of population size and population growth were included in the model as possible indicators of land constraints. The variables were based on the number of households in each community in 2001 as well as the change in households between 1990 and 2001. For communities founded after 1990, the change in number of households is equal to the current number of households.

Several community-level access variables were constructed either from community questionnaires or the GIS. The distance to markets variable is a straight-line distance between the GPS point taken at the center of each community and a GPS point for a selected market community. The market communities were selected based on the majority response to a household question regarding where market goods were bought and sold. Straight-line distance is not likely to be correlated with access in the Amazon since travel routes tend to follow the limited road network and rivers. As an alternative, a

travel time to market variable was constructed based on community responses to questions regarding the amount of time and means of travel to the place where agricultural goods are sold. An additional access variable that was constructed was a variable on whether or not regular public transport is accessible to the community (either in the form of buses, trucks, or canoes), since regular transport may facilitate access to markets, towns, and cities. The final access variable, distance to an urban area, gives an indication of the degree of access that households have to urban markets and services and exposure to urban social and cultural influences. The variable is specified as the mean distance between the community center and the closest of five urban cities (Lago Agrio, Coca, Shushufindi, La Joya de Los Sachas, and Tena).

In relation to land use and natural capital, community variables were constructed to capture trends in relation to hunting and fishing. In each community, households were asked whether hunting and fishing were better, worse, or the same as they were 10 years ago. Based on the household responses community-level binary variables for a downward fishing trend and downward hunting trend were created. Communities were assigned a positive value if the majority of households reported worse hunting and a zero value for those in which the majority of households reported that hunting is better than or the same as 10 years ago. The downward fishing trend community variable was created in the same manner. There is a high degree of consistency within and across communities regarding a worsening hunting trend. In 30 of the 36 communities the vast majority reported worse hunting[6], and overall 85% of households perceived hunting to be worse than 10 years ago. There is similar consistency with fishing trends, though a smaller

[6] The lowest majority in a community coded as worse hunting trend was 70% of households reporting worse hunting.

proportion of households report worsening fishing. In 24 of the 36 communities the vast majority reported worse fishing[7], and overall 72% of households perceived fishing to be worse than 10 years ago. In addition, a binary communal land tenure variable was created based on a household question regarding whether households think of the land they cultivated as their own or as community land. Consistency within communities regarding land tenure and land rights was very high and only one Kichwa community had mixed responses (Bremner and Lu, 2006). The perception of communal land tenure vs. individual land tenure could hypothetically affect the investments that households make in their agricultural areas. Households that perceive that the land is not theirs might be less likely to clear additional land for cultivation, plant perennial crops, or make other improvements to the land, and might therefore perceive non-farm employment as a better livelihood opportunity.

Two additional community natural capital variables that were created were a binary variable for the presence of a communal reserve or other public lands for hunting, and a binary variable for the presence of a river for fishing. The communal reserve variable was created based on household responses to questions about where they hunt, and the community variable was assigned a one if households reported hunting on community land, national park land, or a reserve, and zero if households reported hunting on their own land or land of another community member. The binary variable for the presence of a river was based on the question of where people fish, and after analyzing the results, it was apparent that all communities have access to some nearby river for fishing. As such, the variable was not included in any further analysis.

[7] The lowest majority in a community coded as worse fishing trend was 63% of households reporting worse hunting.

Community variables were constructed to measure local access to labor opportunities. The presence of community run businesses (i.e., ecotourism or canoe-construction) and local oil company activities were assessed in the community survey, which inquired about the presence of business and infrastructure in the area. Two binary variables were created and are positive if either a community business or oil company is active in the area of the community, respectively. The variables do not, however, capture other individually owned businesses or self-employment activities, which might also serve as employment opportunities for members of a community, though self-employment is included in the household survey and makes up a part of the non-farm employment dependent variable. Individuals who were self-employed or who had small businesses were not asked about labor that they hired, thus these possible sources of employment are not included in this local labor opportunities variable.

In addition, a community variable was created to measure community groups that might serve to enhance social capital and serve as social support for individuals and households. The variable is a sum of the number of community organizations in a community, and the types included were: assembly of members, agricultural cooperative, parent's association, church, women's association or committee, sports group, or other association.

At the household level, many variables were constructed from responses to the male and female questionnaires. Ethnicity was not directly asked of respondents, and therefore an ethnicity variable was constructed for households as well as for individuals. The ethnicity of the male and female heads of household was specified according to information collected on the languages spoken, place of birth, community of residence,

and surname. In households where the male and female heads were of the same ethnicity, the household and all individuals in the household were assigned the same ethnicity. There are, however, several cases of mixed ethnicity communities as well as mixed ethnicity households, that is, communities that have households that are not the same ethnicity as the majority ethnicity of the community and households that have male and female heads of household with different ethnicities. The mixed ethnicity households presented a particular challenge in constructing both household ethnicity and children's ethnicity variables. Several specifications of ethnicity were explored in the construction of models. In the household-level model of non-farm employment, households were specified as mixed ethnicity and results were compared with the other ethnicities. Another alternative that was explored was to assign the household ethnicity based on the ethnicity of either the male or female head of household. In the individual-level models of out-migration, however, an ethnicity had to be specified for children of mixed ethnicity households[8] as well as for other adults living in the household[9]. These challenges are discussed further in the out-migration model section below.

Household size and composition variables were created. Household size simply refers to the number of people that were reported as regular residents of the household on a household roster in the female questionnaire. Household composition was created by decomposing the members of the household into number of children, number of male and female teens, and number of male and female adults living in the household. The event history model of out-migration measures migration in each year over a ten-year period,

[8] Only children 15 and older were included in the models

[9] Less information was available for determining the ethnicity of these adults since place of birth and last names were only asked for the heads of household.

and household size should change over the period as new children are born, adult children leave to form their own households, members out-migrate, other family members come to live with the household, and members of the household die. Unfortunately, the survey does not capture complete information for all of these events, which means that the household size variable will have considerable error if included in the model. Several different specifications will be assessed including, number of children ever born and number of children born at the beginning of the ten-year period, though neither of these will accurately capture how many people lived in the household at the time of out-migration events.

Education of the head of household is coded as three dummy variables according to the highest level of education attained by the head. The categories are no education, some primary education, complete primary education, and some secondary education or more. Two specifications of age of the head of the household were created. The first is simply the age in years, and the second specification is coded as three dummy variables, which categorized heads as young (<25), middle (25-49), or old (50+). Households that were headed by a female (usually cases of deceased or permanently out-migrated males) were coded with a single dummy variable. Spanish language ability is categorized as a single dummy variable (speak Spanish or not).

Variables that capture the migration experience of the household were created. Presence of an out-migrant was measured according to whether or not a member of the household had moved to another location within the last decade and had not returned. A variable measuring the number of out-migrants from the household was also specified. In addition, specifications of various remittances variables were explored. Households

reported whether they had received any remittances from each migrant in the last 12 months, and a binary variable was created which measures whether a household received any remittances in the prior 12 months. The amount of remittances was explored to determine whether a continuous variable of remittances could be created. Only 44 households reported receiving remittances and only 38 households reported amounts. The question in the survey actually asks when the person last sent money, how much was sent, and how many times in the last 12 months has the person sent remittances. Assuming that the last amount sent was representative of what was sent each time, a total remittances in the past 12 months variable was created. Of the 38 households, only nine received more than 100 dollars in the year prior to the survey.

Several household variables related to the agricultural production of the household were created. The cultivated area of the household was constructed by adding together the total area that the head of household reported currently for pasture, perennial crops, and annual crops. Detailed information by parcel and by crop was collected in the survey, and all of these land uses were summed for the total area in hectares. In addition, a binary variable was created to capture whether households had received various types of technical assistance related to agriculture that might improve their agricultural production and income, including: coffee or other perennial crops, cattle, rice, corn, yuca, agroforestry, alternative crops, or commercialization. Households that had received any of these types of assistance were given a value of one and households receiving none of the types of assistance were given a zero.

Two household-level social capital variables related to labor sharing between households and shared community labor were constructed. A minga is a type of

traditional communal work that is common throughout Ecuador, and usually refers to shared communal labor that serves the whole community. Mingas often serve for maintenance or construction of community structures or community lands and in-kind labor is provided by households from the community. Households were assigned a positive value for the minga binary variable if they participated in community mingas. Household labor-sharing differs from mingas because the benefits of the labor serve an individual household rather than the community. In-kind labor sharing or exchanges are common among agricultural households during important periods such as planting and harvesting, and labor sharing also is a measure of the social capital of a household. Households were asked whether they exchange labor for working on their farm, and a binary variable was created if they reported such labor sharing.

Finally, several household variables were created to try to measure the financial capital of households. Cattle are often a savings mechanism for rural households in Ecuador, and households were also asked about how many cattle they had at the time of the survey and how many they had in 1990. The variable measuring the number of cattle in 1990 was chosen for this analysis to avoid endogeneity since cattle might be purchased with the wages earned through non-farm employment or migration remittances. Similarly, rural households often purchase consumer goods with their income, and households were asked about various types of consumer goods and the year that they purchased them. Because consumer goods at the time of the survey might be a result of non-farm employment, a variable was created that sums the number of goods the household had five-years prior to the survey, using the year of purchase. In addition, principle components analysis of the household goods in 1996 was used using the

polychoricpca add-on in Stata12 to create a wealth index for households. A few of the assets were not used because of missing values in the correlation matrix, and thus the final set of variables used includes: watch, radio, cassette or other music player, television, oven, kitchenette, refrigerator, sewing machine, bicycle, rifle, and chainsaw. As was discussed earlier, credit can also be an important source of financial capital, and households were asked whether they had received a loan, how much they'd received, from where it had come, and what it had been used for. Unfortunately, however, households were not asked whether they had access to credit, regardless of whether they received a loan. Thus, a binary variable capturing the use of a loan was created, which is a poorer measure than desired for measuring the access to financial capital through credit.

5.3.6 Continuous model of time allocated to non-farm employment

One weakness of the proposed model of participation in non-farm employment is that it does not account for different levels of participation. For example, a household in which one member works just a few days per year, and a household in which several members of the household are consistently allocating a great amount of time to non-farm activities, would be specified as participating in the same manner in the binary logit model. An alternative analysis is to model both the decision to participate and the level of participation.

As a second step to analyzing decisions about livelihood diversification, a model of time allocated to non-farm employment was created. The time data, however, are censored based on the decision to participate in non-farm employment. One alternative for accounting for this censoring is a Heckman's selection model that models the decision

to participate as well as time allocated to non-farm employment. This type of model, however, requires the identification of an appropriate instrumental variable that effects the participation decision but not the decision regarding amount of time spent in non-farm employment. I was unable to identify an appropriate instrument and thus explored different manners of modeling these decisions. For this dissertation I show a two-step model that first models the decision to participate in non-farm employment for all households as a multi-level binomial logistic regression model as described above. In the second step the time allocated to non-farm employment is modeled using a generalized linear mixed model only for those households that chose to participate. The dependent variable for this multi-level model is the total number of days the household spent working in non-farm employment in the last year, which was constructed by adding up the total number of days of non-farm employment conducted by all members of the household during the 12 months prior to the survey date. The model is written as follows:

$$Y_{ij} = BX_{ij} + \lambda Z_j + e_j \qquad \text{(NFE Equation 2)}$$

Where:

Y = number of days the household worked in non-farm employment;

$i = 1, 2, \ldots I_j$ = households in community j;

$j = 1,2, \ldots J$ communities;

X_{ij}= a vector of household-level variables;

B_i is a vector of parameters for effects of independent household variables;

Z_j = a vector of community-level variables;

λ_l is a vector of parameters for the effects of independent community variables L;

e_j is a community-level random effect.

The same set of independent variables used in the model of participation in non-farm employment in the logistic regression models is used for this model, and the models are similarly estimated in STATA I/C12 through the GLLAMM software addition using adaptive quadrature for estimation.

5.4. Method for studying out-migration

The study of out-migration as opposed to livelihood diversification requires consideration of a longer period of time in order to observe a sufficient number of events to allow for sufficient power for statistical modeling. One method of studying out-migration is to rely on retrospective data, collected at the household level, about the migration events of all members of the household over a chosen amount of time. Several problems arise, however, when considering a retrospective history of the ten years prior to the survey. First, some households and individuals in the sample are established after the beginning of the ten-year retrospective period, while other individuals don't experience the event of migration by the observation date. These problems are referred to as right censoring. In addition, important variables such as age, household size and composition, and marital status, for example, may all change during the period of observation. Survival analysis (also referred to as event history analysis) is the most appropriate method for surmounting the statistical challenges of accounting for both censoring and time-dependent covariates (Allison, 1995). Survival analysis is now frequently being used in the study of migration (Barbieri, 2005; Henry et al, 2004; Kulu

and Billari, 2004; Reed et al 2005) and can resolve some of the problems presented above.

Event-history models commonly used for the study of migration data are discrete-time logistic regression models. In the data sets for these models, each individual's history is broken down into a set of discrete units of time, and the discrete units are treated as distinct observations (e.g., person-years). With a data set of person years, a binomial logistic regression model can be estimated with the outcome being the occurrence (y =1) or non-occurrence (y=0) of the event of interest during a person-year.

5.4.1 Data structure for event-history analysis of out-migration

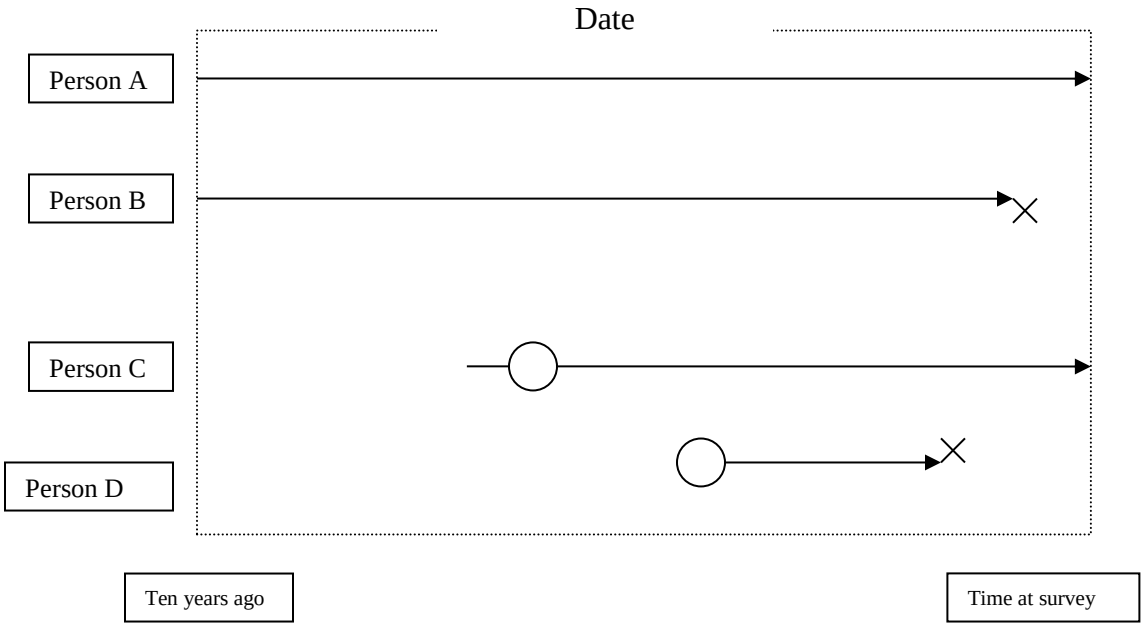
The conceptual model of out-migration suggests that migration decisions are made by households, nested within communities, but also suggests that individual characteristics will mediate decisions about migration. Individual data for members of the household were collected on both a household roster and on an out-migration roster. Information on out-migration was collected for individuals who were over the age of 12 and who had left the community for at least six months between 1990 and 2001 and who had not returned. Consequently, this analysis only models the probability of the last migration during this ten-year period. Each individual's history over the period is broken down into a set of discrete years and each person-year is treated as a distinct observation.

For each person-year observation, I reconstructed the individual's age and the household composition based on the available information. Two complexities of the data, however, require further description. First, due to the data collection method, individuals are only at risk of a migration event starting at the age of 12. Consequently,

many individuals only enter the person-year dataset when they come of age. Second, some individuals arrived to the community during the period, and thus only contribute person-year observations upon arrival to the community.

The situation described above can be visualized in Figure 4, presented below. Individual A is followed for 10 years and never moves, so we have complete information on their duration of residence. Individual B is followed for 10 years and out-migrates during the period. Individual C turns 12 or moves into a sampled household during the study period and consequently only begins contributing person-year observations starting with the year that they come of age or arrive. Person C does not experience an out-migration event before 2001. Finally, person D begins contributing person-years of data midway through the study period and then experiences an out-migration event before 2001.

Figure 4. A representation of censoring in the out-migration dataset.



5.4.2 Model of out-migration

Using the data structure described above, I estimate a multi-level discrete time hazard model as follows:

$$\log (p_{tijk}/ 1- p_{tijk}) = \alpha_t + BX_{(t-1)ijk} + \tau Z_{(t-1)jk} + \delta W_{(t-1)k} + \lambda_i + e_j$$

where-

p_{tijk} is the conditional probability that individual i in household h in community k has an out-migration event at time t.

α_t = the baseline hazard function, which is specified as a piece-wise function in which a dummy variable is entered corresponding to each year

$t = 1,2,\ldots T_{ijhk}$ = year of observation on person i from household j from community k

$i = 1, 2, \ldots N_{jk}$ = individuals in household j from community k

$j = 1, 2, \ldots M_k$ = households in community k

k = 1,2, …K communities

X_{tijk}= a vector of individual time varying and time invariant variables

Z_{tjk}= a vector of household time varying and time invariant level variables

W_k = a vector of community variables

λ_i is a household-level random effect

e_j is a community-level random effect

5.4.3 Dependent variable

A dependent variable was constructed for each person-year with the outcome being the occurrence (y =1) or non-occurrence (y=0) of an out-migration event by the

individual during that year. As was mentioned above, only individuals aged 12 or older are considered to be at risk of out-migration. This age is rather arbitrary, and other age cut-offs can be examined, but the aim is to limit the inclusion of children moving together with parents in the analysis of decisions regarding out-migration. In addition, this was the age on the questionnaire from which data were requested. Households were not to report migrants who had left the household before the age of 12.

5.4.4 Independent Variables

The model includes both time-varying and time invariant independent variables. As was mentioned earlier, age and household composition will vary from year to year, and thus the variables should be allowed to vary for each person-year. One complexity that arose in reconstructing the household composition, however, is that there is incomplete information on the original members of the household in 1990 to be able to reconstruct the household size for every year. Children of the heads of household may have left and formed their own households during the period but unless they out-migrated from the community to form a household elsewhere, they will neither show up in the household roster nor the out-migration roster. Further complicating this is that their actual year of departure from the household is unknown. Rather than rely on incomplete information and introduce error in the models, I chose to omit the household size and household composition variables from out-migration models.

The independent variables included in the model are similar to many of those incorporated in the non-farm employment model. There are, however, some distinctions between the models. First, migration models will include individuals' age, gender, and

education in order to capture individual characteristics as well as household life-cycle factors. As was mentioned earlier, individual ethnicity data were not collected in the household survey, but ethnicity variables for the male and female heads of household were constructed based on available information, and in most households, children were assigned the same ethnicity as their parents. Specifying individual ethnicity in mixed ethnicity households presented a different challenge. Two alternatives were identified: first, these individuals could be assigned mixed ethnicity (though some of the other adults would be incorrectly specified and the heads of household and individuals in the household would have different ethnicities) or they could be assigned the same ethnicity as the community in which they were living. The second alternative would be based on the notion that children would be more influenced by the community they were living in than their parents, but again this could lead to incorrectly specified other adults living in the household. Both of these alternatives were explored, though the first alternative was chosen as the most logical solution. Two possible problems with this specification are first; due to the limitations of the specification scheme only the young child population has mixed ethnicity, and second, heads of household may be of mixed ethnicity but their mixed ethnicity could not be identified from the available information.

In addition, several of the independent variables used to specify models of non-farm employment are not included in the models of out-migration. The number of out-migrants from the household and remittances received are not included as independent variables as they are both endogenous to the dependent variable. A time-varying previous migration variable, however, was created by determining whether another member of the household had left the household in prior years. Total cultivated area,

though it was only collected for the year of the survey, is included in initial models of out-migration, but the variable was examined closely to see how it affects the model estimation and other independent factors. Non-farm employment was not included in the model because information on non-farm employment was only collected for the year of the survey.

5.5 Caveats and limitations related to data and methods

The first limitation of the proposed research is in regards to the sampling of communities. As was mentioned, the selection of communities was not strictly a probability sample. As a result, the external validity of the results from this research are vulnerable to critique. This same type of problem plagues most research with indigenous populations in the Amazon due to incomplete information about them and therefore the difficulty of constructing adequate sampling frames. While a relatively large number of communities were selected, and the communities were selected to include a range of levels of accessibility, size, ethnicity, and locations, the results of this study may not be totally representative of the target population.

Second, several types of migration are not adequately captured by the sampling procedure and the survey instrument. As was mentioned earlier, complete households that migrated prior to the survey in 2001 could not be sampled and are therefore excluded from this research. Some attempts to address this limitation have been proposed for future data collection efforts (e.g., tracking of migrant households), but at this time no data is available to study the out-migration of entire households. An additional limitation is the lack of information on return migrants. No migration information was captured for

individuals who out-migrated between 1991 and 2001 but returned to the community or household prior to the 2001 survey date. Unfortunately, because information was collected only for permanent out-migrants, models of out-migration will consider these individuals as never having left the household. Thus return migration is missing from this analysis.

A third limitation is that past studies of livelihood diversification have used income data to calculate the proportion of income from non-farm sources. In the context of these indigenous populations, income data are likely a poor measurement of household livelihoods due to high levels of unmeasured subsistence activities. A descriptive analysis of the income data from the study suggested poor reliability, especially for households involved in self-employment, and for this reason, models of non-farm employment consider time allocation to non-farm employment rather than income earned from the activity. One problem with using time allocation as a means of measuring livelihood diversification is that livelihood activities may have very different rates of return, thus adoption of a new livelihood activity, even if it takes a large amount of time, could yield little diversification in terms of income.

A final limitation is the possibility that decisions about livelihood activities may not in fact be linear but rather may be occurring through simultaneous decisions. In a prior analysis of land use decisions among the same study population, we assessed the advantages of using simultaneous models to determine the cultivated area of different types of crops, but not other livelihoods or migration. In future analysis of a full set of livelihood decisions we could use simultaneous equations to model land use decisions simultaneously with livelihood diversification decisions.

CHAPTER 6

Descriptive results: demography, livelihoods, and migration

6.1 Introduction

This chapter presents a descriptive analysis of the study population and is broken into four sections. The first describes demographic characteristics of the households and communities of the sample and examines their land use. The second includes descriptive statistics related to alternative natural resource based livelihoods, such as hunting, fishing, and the collection of forest products. The third section examines the characteristics of non-farm employment and of the individuals who participate in non-farm employment. The fourth section provides descriptive statistics related to out-migration.

6.2 Household and community characteristics

The final sample contains 499 households with complete data from both the male and female questionnaire. In three households, neither the male nor the female head of household are indigenous, and they are therefore removed from any further analysis. Hence, Table 5 shows characteristics of the 36 communities, 496 households, 3153 individuals, and 1487 adults aged 12 and over found in the sample[10]. The superscripts in table 5 and in all subsequent tables in this chapter indicate whether means among the different ethnic groups are statistically different. If two or more means share the same

[10] For a few characteristics the number of observations is less than stated here due to missing data.

letter in their superscript they are not significantly different, whereas two means that do not share a letter in their superscript are significantly different. For example, the mean household sizes of the Shuar and the Cofán (6.6 and 5.7 respectively) are not significantly different, therefore they share the letter a in the superscript. The mean household sizes of the Shuar and Secoya (6.6 and 4.2 respectively) are significantly different, thus they do not share a letter in their superscripts.

As was mentioned in the sampling section, the numbers of communities of each ethnicity are distributed roughly in terms of the overall size of the ethnic populations in the study area. Table 5 shows the number of households of each ethnicity, and the greatest numbers of households were selected from the Kichwa and Shuar populations, followed by the other groups, respectively. The Kichwa communities make up 39% of the total communities selected for the study but Kichwa account for 46% of the households and 48% of the individuals in the sample. As already mentioned, up to 22 households were selected in large communities, whereas in small communities there were frequently less households. The end result is a sample that is heavily influenced by the characteristics of the Kichwa population since Kichwa communities tended to be larger than other ethnicities in terms of numbers of households. There are also 29 households, of mixed ethnicity (male and female heads of household of different ethnicities) distributed across the 36 communities. Their characteristics are shown in Table 5, but in subsequent tables the mixed household category is not shown. Table 5 also shows the ethnicity of the individuals living in the sampled households. The distribution of individuals is roughly the same as the distribution of households across the five ethnicities, with exception of the Secoya who tend to have smaller households.

Table 5. Descriptive statistics for households by ethnicity.

	Overall	Kichwa	Shuar	Huaorani	Cofán	Secoya	Mixed
Sample Distribution							
Communities by major ethnicity	36	14	10	7	3	2	0
Households' ethnicity	496	229	97	73	43	25	29
Distance to an urban area (km)*	53.1	56.6^{a}	40.1^{b}	75.7^{a}	43.3^{b}	36.6^{b}	41.2^{b}
Demographic Characteristics							
Total population	3153	1498	640	489	240	120	158
Mean household size	6.2	6.5^{ab}	6.6^{a}	6.7^{a}	5.7^{ab}	4.2^{c}	5.5^{b}
Population under 15 (%)	51.6	52.2^{a}	57.6^{a}	50.5^{a}	53.8^{a}	30.9^{b}	50.1^{a}
Adults with primary education (%)	57.7	61.3^{b}	72.5^{a}	44.6^{c}	24.5^{d}	65.8^{ab}	69.8^{ab}
Adults who speak Spanish (%)	89.3	94.7^{a}	97.5^{a}	67.4^{b}	66.4^{b}	97.6^{a}	96.2^{a}
Adults born in community (%)	42.6	47.4^{b}	10.2^{d}	34.0^{c}	64.5^{a}	44.7^{bc}	39.1^{bc}
Member out-migrated (%)	32.7	37.8^{a}	30.0^{a}	37.7^{a}	31.8^{a}	8.6^{b}	6.1^{ab}
Household-level land use							
Total cultivated area (ha)	3.5	3.9^{ab}	4.8^{a}	1.4^{d}	2.0^{cd}	4.9^{a}	2.9^{bc}
Area cleared in past 3 years (ha)	2.1	2.1^{b}	$2.0.^{bc}$	1.3^{bc}	1.0^{c}	4.1^{a}	2.3^{b}
Owns cattle (%)	16.5	11.5^{cd}	18.1^{bc}	1.6^{d}	3.4^{d}	75.9^{a}	25.9^{b}
Sold crops (%)	64.9	80.2^{a}	73.8^{a}	21.3^{d}	56.8^{b}	44.8^{bc}	36.5^{cd}

Superscripts indicate that means with the same letter are not significantly different

Household values are weighted means using selection weights

*Distance from each community center to closest city weighted by the number of households in the community

The mean distance between a community center and the closest of five cities (Lago Agrio, Coca, Shushufindi, La Joya de Los Sachas, and Tena) weighted by the number of households in a community, indicates the degree of access that households have to urban markets and services. The mean distances to the closest of the five main urban areas range from 36 kilometers for the Secoya compared to 75 kilometers for the Huaorani. Given that accessibility can vary greatly depending on mode of travel, it is important to note that the majority of the communities are not located adjacent to a road and that travel to a city may entail combinations of several modes of transport including via canoes on the river, walking through forests, and traveling on hired transport (bus or truck) via roads.

Table 5 also shows the average household size by ethnicity, which shows that the Kichwa, Shuar, and Huaorani have similar numbers of people per household while the Cofán, Secoya, and mixed ethnicity households are slightly smaller. The Cofán women of reproductive age are younger than the women of the other groups, and as such have had fewer children than women of the other indigenous groups, which contributes to the smaller households (Bremner et al., 2008). The smaller households among the Secoya, in contrast, were related to lower fertility (Bremner et al, 2008).

The indigenous population is characterized by a relatively young age structure, with approximately 51% of the population being under 15. This young age structure is true of all of the ethnicities, other than the Secoya who stand out from the other groups with only 31% of their population under 15. The Secoya age structure is consistent with the small family size and low fertility mentioned above, and suggests that their low fertility is not just a recent phenomenon. In comparison, at the national level only 33% of

Ecuador's population was under the age of 15 at the time of the 2001 census (INEC, 2001). The young age structure of the indigenous groups indicates a large degree of population momentum that will contribute to significant population growth in future decades.

In terms of human capital, there are stark differences between the groups in terms of education and Spanish language ability. Less than 60% of indigenous adults over the age of 15 have completed a primary education. The Cofán and Huaorani have particularly low levels of primary education with 44% and 24% completing a primary education respectively. These groups also lag behind the other groups in Spanish language ability. Among the Kichwa, Shuar, and Secoya, only the oldest members of the population don't speak Spanish. Among the Huaorani and Cofán, in contrast, 1/3 of adults don't speak Spanish, the lingua franca of the Amazon region. Among these two groups it is women who are less likely to speak Spanish. Only 54% of Cofán women speak Spanish in comparison with 79% of Cofán men, and, similarly, 62% of Huaorani women speak Spanish versus 73% of Huaorani men. Inability to speak Spanish suggests that these groups will have limited ability to interact with markets, participate in labor opportunities, and receive health and social services.

The place of birth of the adults in the community gives a sense of the lifetime mobility of the indigenous population in the Amazon. Historically, several of the groups were semi-nomadic and moved periodically between settlements. This is particularly the case for the Huaorani, and mobility appears to remain prevalent today as only 34% of adults are currently living in their place of birth. As was mentioned in Chapter 4, the Shuar living in the study area are principally migrants from the Southern Amazon, and

only 10% of Shuar adults in the sample are living in their place of birth. The prominence of lifetime mobility among the Shuar is also due to the structure of land tenure in Shuar communities. Shuar communities reported that land is already divided among Shuar adults, leaving no community reserve or additional land for young adults to cultivate unless they are given land by their parents (Bremner and Lu, 2007). Levels of lifetime mobility among the Kichwa and Secoya are upwards of 40 to 50%, and the Cofán appear to be the least mobile of the groups with approximately 65% of the adult population living in their community of birth.

Another indicator of population mobility is the percentage of households that have a member who has out-migrated from the community. Overall, approximately a third of households have had a member migrate away from the community during the last ten years and not return, and levels of out-migration are similar for the Kichwa, Shuar, Huaorani, and Cofán. Only the Secoya have significantly lower rates, with less then 10% of households having a member who has left the community. In total, households identified 340 individuals who had out-migrated from the communities since 1990.

Descriptive statistics on land use and livelihoods show some very clear differences among the five groups. In terms of total cultivated area, the Kichwa, Shuar, and Secoya cultivate similar sized areas (approximately 4-5 hectares) for production activities while the Huaorani and Cofán cultivate significantly smaller areas, in the range of 1-2 hectares. The Kichwa, Shuar, and Secoya, though similar in total area cultivated, differ substantially in what they cultivate. The Secoya devote the majority of their land to cattle pasture (4.88 hectares) and cultivate almost no coffee, nearly 70% of households own cattle, and they report having cleared significantly larger areas of forest in the past 3

years than the other groups, mostly linked to cattle pasture. In contrast, only a small percentage of Kichwa and Shuar own cattle (11 and 18%, respectively), hence they maintain significantly less pasture and dedicate more land to perennial cash crops such as coffee and staple crops such as manioc (Gray et al., 2008). Almost no Huaorani or Cofán households own cattle or maintain pasture, and the Cofán cultivate small areas of coffee while Huaorani households don't cultivate coffee (Gray et al., 2008). All of the groups sell some of the crops they cultivate in local or regional markets, but there are stark differences among the groups. Kichwa and Shuar households are heavily involved in the sale of both perennial and annual crops (80% and 73%, respectively). The Cofán and Secoya participate less so (57% and 45%, respectively), and cultivate mostly staple crops for both markets and subsistence. Finally, only 21% of Huaorani households report having sold crops, showing that the majority of Huaorani cultivation is still dedicated to subsistence. As a whole, these statistics on land use suggest a wide range of agricultural systems among the five ethnic groups that ranges from small-scale subsistence agriculture to market oriented cattle raising, with a great deal of diversity.

6.3 Characteristics of alternate natural resource-based livelihoods

The indigenous groups rely on several other natural resource based livelihood activities in addition to agricultural production. Land uses such as hunting, fishing, gathering of non-timber forest products, and timber production are common across the study populations, and Table 6 illustrates these alternate land uses by ethnicity. Almost all indigenous households report that they hunt and fish (93% and 96%, respectively). When questioned further, however, about how frequently they hunt and whether they

have hunted recently, it becomes apparent that many households hunt only a few times a year. Thus, only 38% of indigenous households reported that they hunt at least every two weeks[11], while the majority of houses (62%) report hunting once a month or only a few times per year. While this infrequent hunting is unlikely to contribute substantially to the livelihoods of households, it may still represent an important social and cultural activity that reinforces community ties, reciprocity, and resource sharing (Lu, 2001). Only 2% of households that had successful hunts sold their catch, while 45% shared their hunting catch with other families in the community.

Fishing appears to be a more frequent activity than hunting, as 72% of households had fished within the last week. Fishing, however, appears to have less importance as a social and cultural activity. Only 3% of households reported sharing their fishing catch with other community members, and the majority consumed their catch within the household. As a whole it appears that hunting and fishing are primarily subsistence activities that contribute little to the cash income of households. They do, however, appear to be an important aspect of household livelihoods. Fishing, in particular, is an important source of protein for households. Whereas, hunting is a means of reaffirming food sharing and reciprocity, which then may serve as a means of increasing household resilience during difficult times.

[11] A subsequent question asked whether households had hunted recently (in the past 2 weeks) and 66% of households reported they had hunted within the last two weeks.

Table 6. Descriptive statistics for alternate natural resource based livelihoods

	Overall	Kichwa	Shuar	Huaorani	Cofán	Secoya
Report hunting every 2 weeks or more often during the year (%)	37.6	33.0^{bc}	26.4^{c}	40.5^{bc}	45.6^{b}	67.2^{a}
Hunted in the last 2 weeks (%)	66.2	58.5^{b}	49.8^{b}	77.1^{a}	59.8^{ab}	77.6^{a}
Shared hunting catch with others	45.3	38.1^{b}	37.4^{b}	65.1^{a}	48.3^{ab}	56.9^{ab}
Fished in the past week (%)	72.1	74.8^{ab}	61.6^{b}	80.9^{a}	67.4^{ab}	65.5^{ab}
Practice aquaculture (%)	20.7	10.5^{c}	10.0^{c}	16.6^{c}	44.9^{ab}	58.7^{a}
Sell non-timber forest products (%)	22.0	25.3^{c}	15.1^{c}	39.1^{b}	72.9^{a}	13.8^{c}
Sell timber products (%)	18.3	19.2^{abc}	32.4^{a}	7.9^{c}	5.9^{c}	26.0^{ab}

N=496

Means with the same letter are not significantly different

Household values are weighted proportions using selection weights

There are some ethnic differences among the groups in terms of hunting and fishing, but the differences aren't as stark as the differences in agricultural land use. The Huaorani and Secoya report more regular hunting and greater frequency of sharing than the Kichwa and Shuar, while the Cofán are intermediate. In fishing, only the Huaorani at the high end and the Secoya at the low end are statistically different in terms of recent fishing activity. There is equally low sharing of fish catches among the groups.

Households were also asked to compare current hunting and fishing conditions with the past. In 30 of the 36 communities, the majority of households reported that hunting was worse now than in the past, while households in the other 6 communities reported that hunting was the same or better. Perceptions regarding fishing seemed to be slightly less bleak. In 24 of the 36 communities, the majority of households reported that the fishing was worse than in the past. The worsening of hunting conditions may in fact explain why hunting is now infrequent and why fishing has become so common. Because fishing now appears to be an important part of household subsistence, further declines in fishing yields could serve to push households towards livelihood diversification and out-migration. In contrast, the decline in hunting appears to have already occurred and there may not be any further visible impact of hunting declines on livelihood diversification.

Additional natural resource-based livelihood activities include collection of non-timber forest products, production of handcrafts, aquaculture (principally fish ponds), and harvesting of timber. The collection of non-timber forest products is nearly universal among the indigenous households as a whole and across ethnicities[12]. The selling of non-timber forest products, however, is less common, as only 22% of households reported any

[12] Non-timber forest products included: forest fruits, seeds, medicinal plants (sandre de drago), barbasco (a wild root used for hunting fish, mushrooms, leaves, honey, and other miscellaneous.

sales, and sales were limited to two products (leaves/fibers and Sangre de Drago, a popular topical herbal remedy sold by many Cofán households for various ailments).

Handcraft production for markets, though not reported in the same section of the survey, does appear to be more common, and 13% of households reported some involvement in sale of handcrafts. Handcraft production appears to be concentrated among households in two Cofán and three Huaorani communities as well as a few scattered Kichwa households. The reported income from these sales and the time allocated to these activities vary greatly.

Aquaculture is a relatively uncommon practice, with 21% of households having fishponds, though it is more common among the Secoya and Cofán (59% and 45%, respectively) due to government projects. Like hunting and fishing, aquaculture is primarily a subsistence activity, and almost no households report sales of the fish they harvest from fishponds.

Finally, the sale of timber is reported by only 18% of indigenous households. Timber sales are most frequently made to intermediaries both inside and outside of the community, and it is important to note that most of the timber sales are illegal by Ecuadorian law. Furthermore, qualitative information indicates that common property institutions do not sanction most timber sales, and therefore households are likely to be underreporting timber sales. Nonetheless, some differences do appear among the groups, with Shuar and Secoya households being most active in timber sales, followed closely by Kichwa households, while very few Cofán or Huaorani households report timber sales.

In summary, the descriptive information on alternate resource-based land uses illustrates the importance of these activities for household subsistence. The majority of

households in each ethic group hunt, fish, and collect non-timber forest products for household subsistence. There appear to be less inter-ethnic differences in participation in these activities as compared to agricultural production. Fewer households, however, depend on the sale of these products as a means of generating cash income, though minor exceptions appear to be the Cofán and Huaorani who report higher participation in the sale of non-timber forest products, likely because they practice much smaller-scale agriculture, and perhaps because they have some contact with tourists. Timber sales are an additional means of generating cash for some households, though our survey is not likely capturing the full extent of involvement in this activity. Reported timber sales do appear to be principally among those groups that also have larger investments in agricultural production, including the Shuar, Secoya, and Kichwa, and hence, may be linked to higher overall interaction with markets.

6.4 Characteristics of livelihood diversification

Participation in non-farm employment is the most prevalent livelihood activity after the selling of agricultural crops. Table 7 presents several descriptive statistics related to participation in non-farm employment by households. Just over 50% of indigenous households participate in some form of non-farm employment.[13] Huaorani and Secoya households are particularly active in non-farm employment (73% and 67% of households, respectively). Shuar and Kichwa households show intermediate levels of participation (54% and 45% of households, respectively), and finally, Cofán households are the least active in non-farm employment (33% of households).

[13] Non-farm employment includes all forms of wage labor and self employment activities that are not related to a household's natural resources.

Table 7. Descriptive statistics for household livelihood diversification.

	Overall	N	Kichwa	Shuar	Huaorani	Cofán	Secoya
Participation in non-farm employment	50.7	492	44.9^{bc}	54.4^{ab}	72.9^{a}	32.6^{c}	66.6^{a}
Days of non-farm employment (last yr.)*	127.9	247	117.9^{b}	117.4^{b}	180.7^{a}	183.0^{a}	113.5^{b}
Worked for oil companies (%)	61.4	250	61.1^{b}	84.9^{a}	89.1^{a}	29.1^{c}	31.6^{c}
Worked outside the community (%)	51.8	250	54.9^{ab}	75.1^{a}	50.9^{ab}	31.0^{b}	34.2^{b}
Oil work outside the community (%)	63.8	170	66.2^{a}	79.5^{a}	54.6^{a}	0.0^{a}	66.5^{a}

Means with the same letter are not significantly different

Household values are weighted proportions using selection weights

*Means calculated only for households that had participated in non-farm employment

There is, however, substantially less variation in the amount of time allocated to non-farm employment among those households that choose to participate in the activity. Households participating in non-farm employment dedicated an average of 128 days to the activity during the year prior to the survey. Huaorani and Cofán households dedicated significantly more days to non-farm employment (an average of 181-183 days per year) than households of the other groups, which all allocated similar amounts of time (ranging from 114-117 days).

Because non-farm employment consists of diverse activities, it is also useful to explore the various different types of wage and self-employment that exist. By far the most important source of employment for the indigenous groups is wage labor for oil companies. Of the 250 households that reported non-farm employment, 61% worked as wage laborers for oil companies in the year prior to the survey. For both the Huaorani and Shuar households participating in non-farm employment, oil companies are by far the most important sources of employment (89 and 85%, worked for oil companies respectively), and oil work usually consists of manual labor of various forms (clearing of vegetation and construction being the most common). Kichwa households are also actively involved with oil companies, with 61% of participating households working for an oil company.

In contrast, Secoya households, who are among the most active in non-farm employment participation (67% of households), rely far less on oil companies as a source of employment (31% of participating households work for oil companies). This is in part because households in the largest Secoya community are more likely to work in small business activities in the community than as laborers for oil companies, whereas in the smaller Secoya community in the sample, oil work was more common. Similarly, in two of the Cofán communities there are no households that work for oil companies, whereas in the third Cofán community, nearly all

households worked for oil companies. This suggests that community factors, such as location of oil company installations or work sites, are major determinants of non-farm employment for oil companies. These factors will be explored further in multivariate models.

Households reported many other types of wage employment, including work in tourism, education, and as agriculture/logging laborers. Tourism was the second most common source of employment (14% of participating households worked in tourism), with smaller percentages reporting employment in education (teachers mainly) and agriculture or logging. Self-employment activities outside of one's agriculture and other natural resource based activities are not common and were reported by only 5% of households.

Employment in the rural context is often conceptualized as a livelihood activity that requires temporary absence from the community as sources of employment are rarely located in rural areas (Barbieri 2005, VanWey 2003).[14] Descriptive results on the location of non-farm employment reveal, surprisingly, that only 52% of the households participating in non-farm employment worked at a location outside of their community, while a large percentage of households' employment locations were near or within the community (Table 7). Among the ethnic groups there are few significant differences in mobility for non-farm employment. Shuar households obtain work outside of their communities more than Cofán and Secoya households, but otherwise all groups have statistically comparable mobility for non-farm employment.

Results suggest that a slightly larger percentage of households participating in oil work (64%) work outside of their communities in other rural areas. This does suggest that while some tourism and other sources of miscellaneous employment are available in home communities, the most common source of non-farm employment, oil work, does often require some form of

[14] Thus leading to some of the confusion between off-farm employment and non-farm employment

population mobility. There are no significant differences among the ethnicities in terms of mobility for oil work.

Unfortunately there is no additional information available from the survey that describes this mobility. Useful information would be the distance traveled for employment and how many nights they slept outside of the community[15]. As such, little more can be said regarding the relationship between non-farm employment and population mobility among the indigenous population, which has been a topic of interest among the colonist population in the same study area (Barbieri et al. 2012; Barbieri, 2005).

While livelihood diversification decisions are being examined as a household decision, it is also important to look at the characteristics of individuals who participate in non-farm employment to get a sense of what role human capital plays in determining participation in non-farm employment. Table 8 below presents individual characteristics of participants. The vast majority (89%) of these individuals are men, and they tend to be male heads of household (72%), followed by male adolescent and adult children (14%). Only 11% of participants in non-farm employment are women, nearly all of those being female heads of household. The average age of the individuals participating in non-farm employment is 34 years, with the largest group of participants in the 20-29 age-group (37%). Somewhat smaller percentages of participants are in the 30-39 and 40-49 age groups, and after age 49 participation in non-farm employment drops off markedly, which is unsurprising given that it tends to be manual labor.

Further analysis revealed no significant differences in the characteristics of those working in non-farm employment across the ethnic groups and thus the data are not presented here. While analysis with colonists in this study area has focused principally on non-farm employment

[15] A colonist survey in the same area asked whether they slept outside of the community for the work and the follow-up survey with indigenous being conducted in 2012 includes this question.

as an individual decision (Barbieri and Pan, 2012; Barbieri, 2005), in the indigenous case most variation in participation appears to be at the community and household level, suggesting that household-level models are an adequate approach.

Table 8. Descriptive statistics for individuals participating in non-farm employment

Gender (%)	
Male	89.0
Female	11.0
Relationship to head of HH (%)	
Male head of HH	72.2
Female head of HH	9.0
Child	14.3
Age (%)	
15-19	6.0
20-29	37.3
30-39	26.8
40-49	21.1
50+	8.6

N = 304

CHAPTER 7

Multivariate models of non-farm employment

7.1 Introduction

The bivariate analysis, presented in the prior chapter and in the first part of this chapter, is useful for indicating possible relationships between variables but can also reveal spurious relationships. Multivariate analysis, however, reveals true associations between variables by controlling for other factors that might explain an association between two variables in bivariate analysis. This chapter presents the results and discussion for multivariate models of the determinants of non-farm employment. The first section reviews results from cross-tabulations of key independent variables with the dependent variable, non-farm employment. The second section describes how the multivariate models were constructed. The third section presents the results from a household model of the decision to participate in non-farm employment. The fourth section presents results from the model of time allocated to non-farm employment. The final section includes a discussion of the statistical results.

7.2 Exploratory analysis related to the dependent variable

Cross-tabulations were conducted between the independent variables and the dependent variable non-farm employment. Households that participated in non-farm employment were compared with households that had not, and the results are presented in table 9.

Table 9. Characteristics of households by participation in non-farm employment

Variable	NonFE	No NonFE
Human Capital Assets		
Education of head (H)		*
None(%)	15.1	24.8
Some primary(%)	20.3	27.5
Completed primary(%)	35.1	32.8
Some secondary or more(%)	29.5	14.9
	100.0	100.0
Speak spanish (%) (H)	95.4	87.5 *
Household size (persons) (H)	6.4	6.0
Natural Capital Assets		
Cultivated Area (ha.) (H)	3.3	3.8
Communal Reserve (%) (C)	88.1	89.2
Worsening hunting(%) (C)	91.0	96.1 *
Worsening fishing(%)(C)	85.6	80.6
Social Capital Assets		
Mingas(%) (H)	74.5	73.3
Labor-sharing (%) (H)	61.1	66.6
Number of outmigrants(#) (H)	0.7	0.7
Community organizations(1/0) (C)	3.7	3.9 *
Financial Capital Assets		
Household goods- 5 years prior (#) (H)	1.0	0.9
Receive remittances (%) (H)	8.9	11.8
Cattle in 1990(#) (H)	1.4	1.2
Physical Capital Assets		
Distance to road (km.) (C)	7.5	7.7
Local oil employment(%)(C)	52.4	31.6 *
Other local employment(%)(C)	20.9	14.4
Mediating Factors		
Social		
Age of head (yrs.) (H)	38.4	39.8
Female head of hh(%) (H)	2.1	7.0
Population size (#hh in community) (C)	38.1	37.5
Population growth (#hh) (C)	11.7	6.7
Accessibility		
Travel time to market (hrs.) (C)	3.5	3.2
Access to Public transport(%)(C)	76.7	75.4
Distance to Urban (km.) (C)	60.7	52.0 *
Institutions		
Common property regime(%)(C)	61.6	60.7
External assistance for agriculture (%) (H)	30.5	22.1 *

(H) / (C) – denote Household (H) or Community level variable
*denotes significance at alpha=.05

In this bivariate analysis human capital assets of education and speaking Spanish were significantly higher for households participating in non-farm employment, while there was no significant difference in the household size between the two groups. Natural capital and social capital assets appear to have little relationship with participation in non-farm employment, except for worsening hunting which contrary to expectations appears significantly associated with not participating in non-farm employment. Financial capital and physical capital of the households appears to be unrelated to participation in non-farm employment. Physical capital, particularly the availability of local employment opportunities, appears to be importantly related to participation in non-farm employment. In areas where oil companies or other employers are active, households are more likely to participate in non-farm employment. One surprising result is that while local employment opportunities are important, other access variables such as distance from a road, travel time to market points, and access to transport are not significantly different for the two groups. In contrast, the distance from a household to an urban center is marginally different amongst the two groups, and both are on average more than 50km away from the regions large urban centers and the employment and market opportunities they present. In terms of community institutions, there was no difference in participation in non-farm employment between households living in communities with a communal arrangement of land ownership versus those in which households perceived individual ownership. Contrary to expectations, participation in non-farm employment appears to be greater among households that have received some external assistance for agricultural production and commercialization.

As mentioned above, a more accurate understanding of the household and community factors associated with non-farm employment can be gained through a multivariate analysis

using multi-level models. Several models of non-farm employment and out-migration are presented in the subsequent sections.

7.3 Construction of models of participation in non-farm employment

Variable creation, descriptive analysis, and outlier analysis were completed using the SAS System for Windows Version 11. Observations in the dataset corresponded to 496 unique households in which a man and woman were both interviewed, and for which community-level data from one of 36 communities could be merged. Continuous variables to be used in modeling were examined for outliers using descriptive analysis. One observation was an outlier in terms of total cultivated area[16] and was dropped from the dataset.

In addition, a few variables were not included in models as originally proposed. Access to credit was not included because households were not asked whether they had access to credit, but rather were asked if they had received a loan in the last year. Use of loans does not accurately reflect access to credit, and it is likely endogenous to non-farm employment. The variable was therefore omitted from the models. Presence of a river was not included, because descriptive analysis regarding fishing revealed that all communities had access to some body of water for fishing and hence there was no variation in the variable. Number of cattle in 1990 was removed after determining that many households had not responded to the question because they had been formed after 1990. Second, production goods were not included because at the household-level very few questions asked about possession of production goods. At the community-level very few production goods were identified, and the list of production goods

[16] The household reported 60% more land than the next largest household's total cultivated area. The majority of the land was reported as pasture though the household reported owning very few cattle.

was not comprehensive. The variable was omitted since it poorly assessed the production goods available to households.

Several specifications of accessibility were tested using the four different accessibility variables presented in the descriptive tables above, including: distance to a road, access to regular public transport, distance to markets, and distance to urban areas. In order to ease the interpretation of the accessibility relationships with livelihood diversification, the final models presented include only access to regular transport and travel time to markets.

The final dataset containing all variables for modeling was output to STATA I/C12. A multi-level logistic regression model of non-farm employment was estimated in STATA using the GLLAMM command as discussed in more detail in chapter 5 section 5.3.1. Several variables that were included in initial modeling are excluded from the final models presented. The residence time of the head of household was omitted from the final model as there were many missing values for this variable, it was insignificant, and its exclusion had no significant impact on the log likelihood of the model. Mixed ethnicity households were also removed because their inclusion did not impact the results, added little insight to the results, and the variable was difficult to interpret. In addition, several community variables were found to be collinear, affected models, and were dropped. These included the hunting and fishing conditions, community land tenure and presence of a community reserve, the population size and population change, and community organizations.

In order to further understand household decision-making regarding participation in non-farm employment, a second model of time spent in non-farm employment was constructed only for those households that reported participation. In this second step, the time allocated to non-farm employment is modeled using a multi-level linear regression model for the 250 households

working in non-farm employment. This model was also estimated using the GLLAMM command and is described in more detail in chapter 5. The dependent variable for this model is the log of the total number of days the household spent in non-farm employment in the last year. The variable was constructed by summing the total number of days of non-farm employment reported for all members of the household during the 12 months prior to the survey. The log transformation of non-farm employment was used to normalize the distribution.

7.4 Results of participation model

The results of successive models are presented in table 10. Model 1 includes just ethnicity. Model 2 adds the presence of local employment variables. Model 3 adds accessibility variables, and finally, model 4 adds the household-level variables. Variables are grouped in terms of the asset categories of the livelihoods framework. The final model was estimated with 481 observations due instances of missing data and exclusion of the mixed households. The estimated household and community-level coefficients of the model (B and Z) are presented as odds ratios, equal to e^B and e^Z respectively. Odds ratios that are greater than one indicate a positive association between the independent variable and non-farm employment and odds rations between 0 and 1 indicate a negative association. For continuous variables the odds ratios can be interpreted as the increase or decrease in a household's odds of participation in non-farm employment accompanying a one unit increase in the independent variable. For example, for the travel time variable, an increase in travel time to market of an hour increases the odds of participation in non-farm employment by 4%. For categorical variables the odds ratios can be interpreted as the increase or decrease in odds of participation in comparison to a reference category. For example, a household whose head has some secondary education or more is 7.8

times more likely to participate in non-farm employment than a household whose head has no education.

Table 10. Results of models of participation in non-farm employment

	Odds Ratios			
Variable	Mod.1	Mod.2	Mod.3	Mod.4
Human Capital Assets				
Education (H)				
Some primary (1/0)				2.452
Completed primary (1/0)				2.838*
Some secondary or more (1/0)				7.812*
Speak spanish (1/0)				2.724
Number of men (#) (H)				1.186
Number of women (#) (H)				1.173
Number of children (#) (H)				1.062
Natural Capital Assets				
Cultivated Area (ha.) (H)				0.919*
Social Capital Assets				
Mingas (1/0) (H)				0.466
Labor-sharing (H)				0.721
Number of out-migrants (#) (H)				1.032
Financial Capital Assets				
Wealth score in 1996 (H)				1.010
Receive remittances (1/0) (H)				0.687
Physical Capital Assets				
Local oil employment (1/0) (C)		4.392*	3.989*	5.503*
Other local employment (1/0) (C)		3.067	3.831	3.460
Mediating Factors				
Social				
Age of head (yrs.) (H)				1.011
Age of head squared (yrs.) (H)				1.000
Female head of hh (1/0) (H)				0.495
Ethnicity of household (kichwa reference)				
Shuar (1/0)	2.122	2.327	2.322	1.978
Huaorani (1/0)	6.491*	9.534*	12.011*	18.441*
Cofán (1/0)	3.612	3.790	4.835	9.61*
Secoya (1/0)	3.796	4.049	5.097*	5.573
Accessibility				
Travel time to market (hrs.)			1.044	1.060
Public transport (1/0) (C)			2.558	3.687
Community Random Effect	1.910*	1.180*	1.098*	1.306*
Log Likelihood	-467.5	-461.0	-459.6	-419.2

The model results support many of the hypothesized relationships of the livelihoods framework and asset categories in relation to livelihood diversification in the form of non-farm employment. Human capital assets are highly correlated with participation in non-farm employment. Households in which the head of household had completed a primary education were almost three times more likely to have participated in non-farm employment as those who had no education, and those in which the head of household had completed some secondary schooling or more education were more than 7.8 times as likely to have participated in non-farm employment as those households in which the head of household had no education. The ability to speak Spanish was insignificant in relation to non-farm employment, perhaps in part because almost 90% of households reported speaking Spanish. Neither household size nor the decomposed age-structure of the household into number of children and number of men and women were significantly related to likelihood of participation in non-farm employment. In part this may be because the majority of non-farm employment is by the head of household rather than young adult children, but this finding also suggests that the number of dependents or number of other laborers in the household does not affect the decision of the household to participate in non-farm employment.

Several of the household and community natural capital variables are significant and negatively related to non-farm employment. The size of a household's cultivated area is highly significant and negatively related to non-farm employment. The effect, however, is not particularly strong as each additional hectare of land reduces the likelihood of participation in non-farm employment by just 10%. One possible explanation for the relationship between cultivated area and non-farm employment could be that households engaged in non-farm employment are spending less time working their agricultural lands so that there is a problem of

endogeneity, in which it is actually non-farm employment that is determining the extent of the cultivated area rather than the cultivated area impacting the decision to participate in non-farm employment. As mentioned earlier, Gray et al. working with the same data estimated models of total cultivated area and found that non-farm employment was a significant predictor of indigenous land use. That model also did not control for the possible endogeneity and used a very similar set of independent variables.

In contrast to the natural capital, neither the social capital nor financial capital assets had any bearing on participation in non-farm employment in the model. None of the variables representing social capital assets were significant, including: the participation of the household in communal work parties (Mingas), agricultural labor-sharing, or having a previous migrant in the household. Similarly, financial capital assets, including the household wealth index and migrant remittances, were also not significantly related to participation in non-farm employment.

At the community level, physical capital assets showed mixed results, the presence of local oil activity was highly significant in all models and positively related to participation in non-farm employment, while the other local employment opportunities was only marginally significant ($p<0.1$) in several of the models. Households in communities in which oil companies are active in the area were five times more likely to participate in non-farm employment than households in communities where there was no local oil activity. These findings illustrate the importance of the local labor market created by the oil companies for indigenous livelihood diversification

Several mediating factors at the household and community level also appear to play an important role in determining participation in non-farm employment. The age and gender of the head of household were not significant, but ethnicity of the household was very important in

determining participation in non-farm employment even when controlling for other asset categories and meditating factors. In comparison with the reference category, Kichwa, the Huaorani and Cofán households were significantly more likely to participate in non-farm employment. The Shuar had equally low odds of participation in comparison with the Kichwa, and the Secoya fluctuated between having significantly higher odds than the Kichwa but in the final model were only marginally significantly more likely to participate ($p<0.10$). The ethnicity that stands out are Huaorani households whose odds of participating in non-farm employment are significantly higher than even the Cofán and Secoya.[17]

The included accessibility measures, travel time to market and presence of regular transport, were both not significant. The travel time to market variable was expected to positively influence participation in non-farm employment, households in communities that have to spend more time traveling to markets to sell their agricultural crops and buy food and other consumer products were equally likely to participate in non-farm employment.

7.5 Results of model of time allocated to non-farm employment

The final results of the model of time that households allocate to non-farm employment are presented in table 11. Variables are again grouped in terms of the asset categories of the livelihoods framework. The final model was estimated for 229 households that participated in non-farm employment, reported the number of days they had worked in the past year, and had complete information for all independent variables. A few households that reported non-farm employment did not report the number of days and were thus excluded from the model. The estimated household and community-level coefficients of the model are presented in table 12.

[17] Models with alternative specifications of the reference group were analyzed for ethnic group comparisons but are not shown here.

The coefficients of categorical variables were transformed by (e^{β} - 1), following the recommendations of Halvorsen and Palmquist (1980) for log-transformed dependent variables, which allows the coefficients of both continuous and categorical variables to be interpreted as the proportional increase in time allocated to non-farm employment resulting from a unit increase in the predictor. In the case of the dummy variables that are used to specify categorical variables, the interpretation then is as a pairwise comparison of the proportional difference of days allocated to non-farm employment between the category specified by the dummy variable and the reference category. Models with alternate specification of the reference categories were also analyzed to examine the significance of all pairwise comparisons but are not displayed in the table. The results for these various pairwise comparisons are, however, discussed in the results below.

The model of time allocated to non-farm employment resulted in fewer significant independent variables than the participation model, and only a few variables were found to influence the time that participating households allocated to non-farm employment. Most of the human capital, natural capital, financial capital, and physical capital assets did not significantly influence the amount of time that households spent participating in non-farm employment with a few exceptions. In contrast to the participation model, the social capital factors were found to be significant and positively associated with non-farm employment. Most mediating factors including: age and gender of the head of household, ethnicity, population size and growth, and community institutions were also insignificant. The findings presented in table 11 are discussed in more detail below.

Table 11. Results of model of time spent in non-farm employment

Human Capital Assets			
Education of head (H)	Coefficient	p value	
Some primary(1/0)	-0.004	0.974	
Completed primary(1/0)	0.154	0.262	
Some secondary or more(1/0)	0.249	0.043	*
Speak spanish (1/0) (H)	0.052	0.655	
Number of men (#)(H)	-0.018	0.393	
Number of women (#) (H)	0.028	0.412	
Number of children (#) (H)	-0.044	0.018	*
Natural Capital Assets			
Cultivated Area (ha.) (H)	0.008	0.599	
Social Capital Assets			
Mingas (1/0) (H)	0.111	0.338	
Labor-sharing (%) (H)	-0.184	0.000	*
Number of out-migrants(#) (H)	-0.050	0.017	*
Financial Capital Assets			
Wealth Score in 1996 (H)	0.005	0.709	
Receive remittances (1/0) (H)	-0.032	0.703	
Physical Capital Assets			
Local oil employment (1/0)(C)	0.095	0.284	
Other local employment (1/0)(C)	0.161	0.209	
Mediating Factors			
Social			
Age of head (yrs.) (H)	0.009	0.414	
Age of head squared (yrs.) (H)		0.847	
Female head of hh (1/0) (H)	0.147	0.310	
Ethnicity of household (kichwa reference)			
Shuar (1/0)	0.045	0.661	
Huaorani (1/0)	0.208	0.296	
Cofán (1/0)	0.023	0.929	
Secoya (1/0)	-0.079	0.616	
Accessibility			
Travel time to market (hrs.) (C)	-0.016	0.394	
Access to Regular transport (1/0) (C)	-0.134	0.307	
Constant	1.611	0.000	*
Community Variance Component (0.035) *			
Household Variance Component (0.137)			
Log Likelihood -179.45			

The various comparisons between levels of education of the head of households and the time allocated to non-farm employment were all insignificant. Households with heads who had some primary education or had completed primary education spent similar amounts of time working in non-farm employment as those who had no education. Those households where the

head of household had some secondary education or more spent significantly more time working in non-farm employment. There was no difference in the time allocated to non-farm employment among those who spoke Spanish versus those who did not speak the language.

The results from the household composition variables indicate that the number of adult men and adult women did not affect the time allocated to non-farm employment, but the number of children in the household was significant and negatively associated with time allocated to non-farm employment. There was a 4.5% decrease in the number of days worked in non-farm employment for each additional child in the household.

Among the social capital asset variables, the coefficients for labor-sharing and community organizations were both negative and significant. Households that reported helping other households in the community through exchanges of in-kind agricultural labor spent 20% less time participating in non-farm employment. There was also a 14% decline in the number of days spent working in non-farm employment for each active community organization reported in the community. In addition, the number of out-migrants from the household is significant, and there is a 5% decrease in the number of days of non-farm employment for each additional out-migrant from the household.

Neither of the physical capital variables related to the proximity of labor opportunities impacted the time spent in non-farm employment. The ethnic group comparisons, which were so important in the participation model were not significant. Neither of accessibility variables was significant.

7.6 Discussion of non-farm employment results

The findings on non-farm employment support many of the hypotheses presented in chapter 3 that relate indigenous household's non-farm employment to the livelihoods literature and theories related to labor market returns and risk mitigation. As a whole the results suggest that non-farm employment is a critical livelihood diversification strategy for indigenous households. Over 50% of households participate in non-farm employment, and on average those households spent more than 120 days of the year engaged in this form of livelihood activity.

Human capital assets are important determinants of participating in non-farm employment. Households with more education are far more likely to diversify their livelihoods by participating in non-farm employment. This is not to say, however, that there is not a labor market for households with little education. In fact human capital is not a major barrier to participating in non-farm employment--70% of households active in non-farm employment had a primary education or less. Language skills also do not appear to be a significant barrier to employment. Almost 90% of adults speak Spanish and the models do not suggest that speaking Spanish, independent of other factors, is linked to non-farm employment. Other human capital variables that influence the available labor in the household such as the number of adults and the number of children were not related to non-employment as expected.

Together these results suggest that, while human capital is an important predictor, non-farm employment requires only modest levels of human capital assets or investments from households. The fact that higher levels of education are increasingly linked with participation in non-farm employment suggests that aspirations among those with more education may change, and that there may be higher labor market returns for those with higher levels of education.

While neither of these hypotheses are tested here, they are areas that should be examined in more detail in future research.

Natural capital assets, as expected, are strongly associated with the likelihood of participating in non-farm employment. The bivariate results indicated only modest differences between participating and non-participating households in terms of natural capital. The multivariate models indicated, however, that households with more natural capital assets, specifically larger cultivated areas are less likely to participate in non-farm employment. This finding suggests support for the theory that livelihood diversification to non-farm employment activities is a means of diversifying risk among those households who have few additional natural capital assets to rely upon for their livelihoods or to draw upon during difficult times. Alternatively, it may be that non-farm employment is an easier means of accumulating financial capital for agricultural investment or risk mitigation among those households that have little means of accumulating financial assets through natural resource based livelihood activities. Surprisingly the natural capital assets did not have any bearing on the amount of time that households spend working in non-farm employment, which suggests that agriculture and other natural resource based livelihoods remain important even as households diversify their livelihoods, and there does not appear to be a clear tradeoff in which those households cultivating less area spend more time in non-farm employment. Natural resource-based livelihoods remain important for indigenous households and are a key component of their livelihood strategies-despite the opportunities of non-farm employment.

The findings for social capital assets are perhaps the most surprising among all of the groups of asset categories. Contrary to expectations various measures of social capital had no influence on the likelihood of households to participate in non-farm employment. The bivariate

results indicated little difference between households participating in non-farm employment and those not participating, and the multivariate model confirmed these results. Social capital variables were important, however, in the model of time spent in non-farm employment. Labor-sharing and the number of out-migrants both decrease the amount of time that households spend in non-farm employment. Two possible explanations for this result are first that the strong social connections may serve to lessen the risk that households perceive to their natural resource based livelihoods, which might lessen the investment of time in non-farm employment. If this were the case, however, one might expect to see some influence of social capital variables on the likelihood of participation in non-farm employment, which is not the case here. A second possible explanation is that strong social capital might result in more intra-community sharing of non-farm employment opportunities. For example, qualitative information from some communities indicates that households may take turns working for oil companies or in tourism when opportunities arise. A similar rotating schedule of households participating as park guards was observed in another community. These types of community arrangements are probably more common in communities with strong social capital, and could result in less total time allocated to non-farm employment for these households.

While the number of out-migrants variable was hypothesized as providing increased access to information about non-farm employment opportunities, the opposite result here suggests that the variable may be capturing a different factor. A possible explanation is that the loss of the labor potential of the out-migrants decreases the amount of time spent in non-farm employment. This, however, is inconsistent with results related to the number of men and women, which were both insignificant. Furthermore, the general lack of remittances from out-migrants to origin households discussed in chapter 8, as well as the insignificance of the

remittances variable for either participation or time spent in non-farm employment, also negates the idea that households are substituting remittance income for non-farm employment income. Further study of the out-migration results in the next chapter might provide more insight on this finding.

In relation to financial capital, non-farm employment was hypothesized to be both a means of capital accumulation for households with little access to credit or other financial capital, as well as a risk mitigation strategy for those who had few financial capital assets. Both measures of financial capital assets, including household goods wealth index and migrant remittances were insignificant. One possible explanation is that the chosen variables are not accurately measuring the financial capital of indigenous households.

Physical capital assets, specifically the local oil business infrastructure, were among the strongest predictors of participation in non-farm employment. Households in communities with local sources of oil employment were far more likely to work in non-farm employment. The proportion of households that are obtain local employment is somewhat surprising in these indigenous communities that are often conceived of as remote from urban centers and sources of employment. In fact, 48% of households didn't even travel from their community in order to work in non-farm employment, principally with oil companies and in tourism. The presence of local sources of employment did not, however, affect the amount of time that households dedicate to non-farm employment. In other words, once a household identified a source of employment and traveled outside of their community to work, they spent similar amounts of time working as those that had access to local employment opportunities.

Of the various mediating factors that were included in the models, individual factors such as the age and gender of the head of household were not important determinants of non-farm

employment in either model. The age results indicate that life cycle does not influence participation in non-farm employment. The descriptive results on gender indicate that the majority of those working in non-farm employment were the adult heads of household but the fact that female headed households were just as likely to participate in non-farm employment and spent just as much time working in non-farm employment indicates that either the female head of households or her young adult male children work in non-farm employment.

The most important mediating factors as expected was household ethnicity. The descriptive analysis revealed large differences in participation in non-farm employment by ethnicity. The model of participation supported the descriptive results, and, when controlling for other factors, the Huaorani and Cofan still stood out from the other groups in terms of likelihood that households would participate in non-farm employment. The Cofan had intermediate levels of participation and the Shuar and Kichwa were the least likely to be participating in non-farm employment. The Shuar and Kichwa are also quite active in agriculture, and while total cultivated area is already controlled for, there is the likelihood that households from these ethnicities are also more active in commercial crops that can be sold at markets for cash. There were no significant differences among the ethnicities, however, in the time allocated by households to non-farm employment when controlling for other factors, suggesting that once households make the decision to participate in non-farm employment, they dedicate similar amounts of time to it, regardless of ethnicity.

Finally, in terms of accessibility there are surprisingly few interesting results. Contrary to expectations about rural employment opportunities, the descriptive results indicate that almost 50% of households do not need to travel to access non-farm employment opportunities. As is mentioned above, the multivariate models indicate the importance of local sources of jobs in

determining whether households participate in non-farm employment. The travel time to the nearest market was not found to be significantly associated with the likelihood of participating in non-farm employment nor the time allocated to the activity. Accessibility measures in the model are probably not capturing the time that one would travel to access labor opportunities, but rather the amount of time households have to travel to sell their agricultural crops or other goods and services at markets, since the several accessibility measures that were available were related to markets and urban areas, neither of which are the places of employment. One notable lesson here is that with each livelihood activity it is important to understand the different possible accessibility measures that should be measured and examined in models, and then think carefully about how the measure of accessibility might impact not just the livelihood being studied, but also other livelihoods.

CHAPTER 8

Descriptive and multivariate analysis of outmigration

8.1 Introduction

This chapter presents the results and discussion for the models of outmigration and is divided into four sections. The first section reviews results from cross-tabulations of key independent variables with the dependent variable, out-migration. The second section describes how the models were constructed. The third section presents the results from a discrete time event-history model of the decision to out-migrate "permanently" from the household, and the final section includes a discussion of the statistical results related to outmigration.

8.2 Exploratory descriptive analysis of out-migration

Cross-tabulations were conducted between independent variables and the dependent variable out-migration from the household. Individuals who had left the household and the community permanently and who had been gone for at least six months and who did not have plans to return were classified as out-migrants. The characteristics of out-migrants and some of their household characteristics are presented in Table 12. The out-migrants are divided by gender in order to get a better understanding of possible gender differences between male and female migrants.

One-third of indigenous households reported that a member of the household out-migrated during the ten years prior to the survey and had not returned. As was mentioned earlier, only the Secoya differ in migration frequency with only eight percent of households

reporting the out-migration of a household member. Women make up a larger percentage of the out-migrant population (57% female vs. 42% male), and the vast majority of the reported out-migrants are children of the heads of household. This gender difference in migration is opposite that seen among colonist households in the study area, in which males were more commonly out-migrants (Barbieri and Carr, 2005). As would be expected given the sample characteristics, Kichwa make up a large percentage of the out-migrant population. Among the Kichwa, males and females appear to be equally likely to out-migrate, but there are some gender differences among the groups with more Shuar and Cofan women out-migrating than men and more Huaorani men out-migrating than women.

Many of the reported out-migrants left the households at very young ages. More than 60% of the out-migrants had left the household before they were 20 years old, and 20% had left before age 15 (Many households reported young out-migrants before the age of 12 even though the questions was only supposed to capture data for those over 12. Another third of the migrants left the household between 20 to 29 years. There are some interesting gender differences related to age of migration, as far more women move between 15 and 19 than 20 to 29, whereas an equal proportion of men in the two age groups migrate. The low prevalence of out-migration at later ages may in part be because children over the age of 30 will have, in most cases, already formed their own households, and they may no longer be considered members of the household by their parents. Migration at older ages, thus is less likely to be captured by the survey, and likely includes movement of an entire household, which is not captured in this survey data.

Table 12. Characteristics of out-migrants by gender

Households with out-migrants (%)	32.7	
Gender (%)		
Male	42.7	
Female	57.4	
	Males	Females
Relationship to head of HH (%)		
Head of HH	1.4	0.0
Child	81.6	83.2
Other	17.0	16.2
Ethnicity (%)		
Kichwa	57.1	57.4
Shuar	14.3	17.8
Huaorani	18.4	12.2
Secoya	0.7	0.5
Cofán	5.4	9.1
Mixed	4.1	3.0
Age at migration (%)		
0-14	21.8	23.4
15-19	35.4	46.2
20-29	34	24.9
30+	6.8	4.1
Education [a] (%)		
None	2.3	2.8
Some primary	15.5	31.3
Complete primary	35.7	37.4
Some Secondary or more	46.5	28.5
Marital Status at migration [a] (%)		
Single	49.2	32.2
Married or union	50.0	66.7

N = 344

[a] only individuals >=12yrs. at migration

Education of the out-migrants at the time of migration is higher than the indigenous population as a whole, and in part this is because the youth, who make up the bulk of the out-migrant population, are more likely to attend school and complete education than were their parents and grandparents. Among the out-migrants, the majority of individuals had completed

primary school or had some secondary schooling before leaving the household. Female out-migrants had slightly lower-levels of education than males with a larger proportion having just some primary schooling and a smaller percentage having some secondary schooling.

One surprising result is that the majority of those who out-migrated were married or in a union at the time they left the household, though this is heavily influenced by the female out-migrants, two thirds of whom were already married when they left. Only half of males were married when they left. Unfortunately, the questionnaire did not gather information about other people with whom the out-migrant migrated. Thus it's difficult to determine if they married others in the community, and then chose to move as a couple, or whether they married individuals from outside of the community and then moved to their wife or husband's community. Information on the reasons for out-migration below, however, provides some additional information regarding this issue.

Table 13 describes the migration event and does confirm that the principle reason for out-migration is to accompany a spouse or relative (58%), suggesting that marriage migration is a common form of outmigration reported by the indigenous households. The other main reported reasons for out-migration are to look for work (14%) and for schooling (10%). There are some gender differences in the reasons for migration, though for both men and women, the principle reason is still to accompany a spouse or relative (67% of women and 42% of men). A greater percentage of men than women migrated for work reasons (21% vs. 8%), education (15% vs. 8%), and military service (7% vs. 0%).

At the time of the migration, the majority of the out-migrants' economic activity was reported to be work on the farm (44%), and only a very small percent were doing non-farm work. Given that the migrants are largely children of the household, it is likely that most were

helping on the family agricultural fields before leaving. In addition, a reasonably high percentage of out-migrants were either students (21.6%) or performing domestic labor around the house (23.9%) at the time of migration. Gender differences in out-migrants work at the time of leaving are clearly related to the gendered-dimensions of work in the indigenous household, and it is unsurprising that women were reported to be working in domestic chores, farm labor, and school studies, while the men were more often involved in farm labor, school studies, and non-farm employment.

The vast majority of indigenous out-migrants (91%) move to other destinations in the Amazon. Most chose to move to other rural destinations in the Amazon (67.5%), but almost a quarter (22% of out-migrants) moved to urban areas of the Amazon. Less than 10% of the indigenous moved to destinations outside of the Amazon, despite the fact that the major economic urban centers in Ecuador are in the highlands and coastal areas. Among colonists in the study area, women were more likely to move to urban destinations within the Amazon than men (Barbieri and Carr, 2005), but among the indigenous, no gender differences in destinations were observed. Males and females had similar patterns in relation to the rural and urban Amazon.

The literature on migration suggests that first moves may simply be a stepping stone for subsequent moves, but the survey also asked the household to report the current place of residence of the out-migrants, and the results are almost identical to the original destinations. Out-migrants are still residing principally in other rural areas of the Amazon, and almost no indigenous have left the Amazon completely.

The vast majority of households reported that they had not received any economic support from migrants in the last 12 months. Only 20% of the households reported receiving any

remittances from the out-migrant during the 12 months prior to the survey, and further examination of the remittance amounts of those reporting, suggests that less than 10 households in the entire sample reported remittances that would total more than $100 per year. This finding along with the low number of households that report the individual out-migrated for work suggest that most households may not be sending individuals out from the community for the economic gain of the household or for livelihood diversification as was originally hypothesized.

Table 13. Characteristics of the migration event

Reason for migration [a] (%)	
Accompany spouse or relative	56.1
Look for work	13.6
Schooling	10.6
Other	19.7
Economic activity at migration [a] (%)	
Worked on farm	44.5
Non-farm work	6.1
Student	21.6
Domestic work	23.9
Destination [a] (%)	
Rural Amazon	68.5
Urban Amazon	22.1
Rural Outside Amazon	1.7
Urban Outside Amazon	7.6
Sent Remittances (last 12 months)	
Yes (%)	20.9
No (%)	79.0

N=340

[a] only for individuals >=12yrs. at migration

As a whole, the descriptive analyses of out-migration suggest that individual characteristics are important, and that out-migrants move for complex social and economic reasons. The predominant reasons for moving and the lack of significant remittances provide little evidence to suggest that out-migrants move specifically for the benefit of the household or

as a household strategy for livelihood diversification, as is theorized by the livelihoods framework, suggesting that other socio-cultural explanations for migration such as marriage, establishment of a household, and acquiring land may be more important. In addition, the destinations of out-migrants suggest that the indigenous are largely engaged in rural-rural migration, and are out-migrating from their origin communities at far lower rates than rural colonist households in the study area, 59% of which reported out-migrants (Barbieri and Carr, 2005).

The prominence of non-farm employment and availability of rural work opportunities with oil companies could be one possible explanation for the infrequent out-migration related to economic reasons. One possible explanation of the prominence of migration for family reasons is the small size of indigenous communities and the close kin relationships that exist within communities. In many communities, out-migration to another community of the same ethnicity may be necessary to find a spouse who is not a close relative. Further insight into the determinants of both non-farm employment and out-migration will be gained through the multivariate analyses presented in the subsequent chapters.

8.3 Construction of models of outmigration

The dataset construction and variable creation were completed using the SAS System for Windows Version 11 as well as STATA I/C 12. Data for individuals who were non-migrants were expanded from each household's roster, collected in the female questionnaire. The resulting dataset included individuals as observations with their individual, household, and community characteristics. Next, the data for out-migrants were expanded from the migrant roster, also collected in the female questionnaire, and the resulting dataset included the

individual characteristics of 344 out-migrants as well as their household and community characteristics. The non-migrant and migrant datasets were appended so that a complete dataset was created containing observations for 3527 individuals representing migrants and non-migrants. Finally, the individual dataset was expanded so that each person-year from 1990 to 2001 represented a single observation in the final dataset to be used for discrete-time event history analysis.

Several new variables were created both for data management and modeling. A time-varying variable for age was created so that age would vary with each person-year. All person-year observations in which the age of the individual was under 12 years old or over 59 years old were dropped from the dataset because data in the migrant roster were only to be collected for out-migrants who left at the age of 12 or later, and individuals under 12 and over 59 were considered to be not at risk of an out-migration event. In addition, all person-year observations for out-migrants that were after the year of the migration event were dropped from the dataset. Finally, information on the year of arrival to the community, which was collected for individuals on the household roster, was used to drop person-year observations that occurred before the individual had arrived in the origin community. The same information, however, was not available from the migration roster, and thus in order to censure person-years for migrants that might have occurred before their arrival in the community, the year of arrival of the head of household was used as a proxy for the out-migrant's year of arrival. One additional time-varying variable related to migration experience of the household was created. The year of the first migration experience of the household was used to create a binary previous migration experience variable. The person-years after a household experienced its first out-migration were assigned a positive value for all remaining members of the household, whereas all person-year observations

in which the household had no experience with out-migration were assigned a zero. The final step was the creation of a set of dummy variables for each year from 1990 to 2001 in order to control for fixed effects related to time that might have influenced the odds of migration.

The end result is a dataset, in which each individual contributes multiple person-year observations in according with their age, presence in the community, or out-migration. Each observation also contains the time varying and time invariant individual, household, and community characteristics that are hypothesized to influence out-migration. Out-migration was coded as a binary variable, with a positive value corresponding to a move in that person-year, in which the individual had left for 6 months and had not returned. The GLLAMM command in STATA I/C12 was used to specify a multi-level discrete-time event history model with random community effects as described in more detail in Chapter 5 above. After running the model for all individuals, separate models for men and women were developed to compare gender differences in the factors that influence out-migration.

8.4 Results of the model of out-migration

The results of all three models (all individuals, men, and women) are presented in table 14 below. Individual characteristics are presented first and then variables are grouped in terms of the asset categories of the livelihoods framework.

Table 14. Results of model of out-migration

Odds Ratios

	All	Women	Men
Gender (1/0) (I) *(male reference)*	1.757**		
Age (I) (15-19 reference)			
12-14	0.789	0.975	0.659
20-24	1.696*	1.630	1.875
25-29	1.117	0.856	1.559
30 plus	0.253**	0.219**	0.367*
Never Married	0.797	0.697	1.072
Human Capital Assets			
Education (I) (no education reference)			
Some primary (1/0)	3.948**	4.773**	2.139
Completed primary (1/0)	4.108**	4.745**	3.068
Some secondary (1/0)	3.186*	3.489*	2.682
Completed secondary or more (1/0)	4.503**	5.873*	3.627*
Natural Capital Assets			
Cultivated Area (ha.) (H)	0.999	0.990	1.004
Social Capital Assets			
Mingas (1/0) (H)	0.742	0.930	0.578
Labor-sharing (1/0) (H)	1.193	1.177	1.385
Previous out-migrant (H)	3.515**	3.869**	3.438**
Physical Capital Assets			
Local oil employment(%)(C)	0.838	1.079	0.536*
Other local employment(%)(C)	1.301	1.430	1.031
Mediating Factors			
Social			
Ethnicity of household (kichwa reference)			
Shuar	0.891	0.809	0.835
Huaorani	1.270	1.216	1.156
Cofán	0.920	1.337	0.531
Secoya	0.270**	0.102**	0.389*
Mixed	0.780	0.991	0.377
Accessibility			
Travel time to market (hrs.) (C)	0.955	0.972	0.958
Constant	0.008**	1.219	0.013
Community Random Effect	0.051*	0.000	0.000
Log Likelihood	-2030.1	-1119.1	-869.1

*p<.05, **p<0.01

Note: All dummy variables for years 1990-2001 were insignificant and are not shown

The final model with all individuals was estimated with 14754 person-year observations and 296 migration events due to the censoring discussed above and instances of missing data. The estimated coefficients of the model, β, are presented as odds ratios, equal to e^{β}. The odds ratios can be interpreted as the multiplicative effect of a one unit increase of the predictor on the probability of out-migration relative to the probability of no outmigration. Odds ratios that are greater than one indicate a positive association between the independent variable and out-migration and odds rations between 0 and 1 indicate a negative association. For categorical variables the odds ratios can be interpreted as the increase or decrease in odds of participation in comparison to a reference category.

In general very few of the household or community independent variables were found to significantly influence out-migration, and primarily the characteristics of individuals determined the odds of out-migration. The age of the individual was significant and negatively associated with migration indicating that the odds of migration decreases with each additional year in age. The specification of the model using age groups rather than a continuous variable for age reveals that the relationship between age and out-migration is actually curvilinear, and the odds of migration is higher in the 15-19 and 20-24 age groups than the 12-14 or 25-29 age groups. The odds of out-migration declined significantly for adults who are over 30. Gender was also significantly associated with out-migration, with women being 1.7 times as likely to out-migrate as men. Finally, marital status of the individual is insignificant and people who are single were just as likely as those who were married or in a union to out-migrate.

Human capital was an important factor influencing out-migration as education was significant and positively associated with migration. The likelihood of migration increased with the level of education completed by individuals. Even those with just some primary education

were 3 times as likely to out-migrate as those with no education. Similarly, those who had completed primary and those with some secondary education were approximately 3 times as likely to out-migrate. Those who had completed a secondary education were most likely to out-migrate and were five times as likely to depart the community as those with no education. In a specification of the model not shown, the odds of migration among those who had completed their secondary education were significantly higher than those who had completed primary.

At the household and community levels, the natural capital factors including the total land area of the household in 2001, was not found to be significantly associated with the odds of out-migration. The results suggest that cultivated area as specified in the model has little influence on out-migration among the indigenous population.

Similarly, the social capital variables for the household were not significantly associated with out-migration, except for the migration experience of the household. Individuals were more than 3 times as likely to out-migrate after a previous member of the household had out-migrated from the community, suggesting that information from the experience of the first out-migrant influences the migration decision of other members of the household.

Surprisingly, neither the local employment opportunities nor various specifications of accessibility to markets and urban areas were found to be significantly associated with out-migration. Individuals in communities with local employment opportunities were just as likely to out-migrate as those in communities without these local opportunities. Similarly, those living in communities distant from local markets or from urban areas were just as likely to out-migrate as those close to urban areas.

Finally, there were few ethnic differences related to the likelihood of out-migration. Only the Secoya were found to differ from the other groups, and individuals who were Secoya

were far less likely to out-migrate from their communities in comparison to the other groups. Cofan, Shuar, Huaorani, and Kichwa individuals all had similar odds of out-migration.

Modeling males and females separately reveals just a few small differences in the factors that influence out-migration. For both men and women, the odds of migration are highest among the young age groups between 12 and 29 and then decline significantly after 30. Marital status is insignificant for both groups, despite the descriptive findings that indicated that a greater percentage of females who out-migrated were married than males. Among both men and women a previous out-migration of a member of the household significantly increases the odds of out-migration. Both men and women were three times as likely to migrate if a previous member of the household had already out-migrated from the community.

The influence of education on the odds of out-migration, however, does differ between males and females. For men, only those who had completed a secondary education stood out as being more likely to out-migrate than the reference group, those with no education. Among men, individuals with all other levels of completed education had similar odds of migration as those with no education. Among women, however, individuals with any level of education had greater odds of out-migration than those with no education.

The final observed difference is the significance of the presence of an oil business near the community. The odds of migration were significantly lower for men living in communities where oil companies were active in the area. These individuals were only half as likely to out-migrate as those living in communities without active oil companies in the area.

8.5 Discussion of the out-migration results

The examination of individual, household, and community level influences on out-migration revealed that individual factors are the principle drivers of out-migration from indigenous communities. This finding is in stark contrast to the results for non-farm employment for which household and community influences figured prominently in the decision to participate and in the amount of time allocated to non-farm employment. In general, migrants are most likely to be young, better educated, and from households in which someone has already out-migrated.

The odds of migration are highest among adolescents and early adults and then decline precipitously after 30, though age was less important among men than women. This, finding, however, may also be influenced by the data itself. Data were collected only for people who are usual residents of the household and not for all children. Adult children likely form their own households sometime in young adulthood and then are no longer considered residents of the household. If these adults then decide to out-migrate with their entire household then their out-migration would not be captured by the survey, which did not collect data for whole households that had out-migrated unless they were part of the larger household that was interviewed.

Education is another important factor that significantly increases the odds of out-migration, particularly among women who are more likely to out-migrate with any level of education. Among men, the odds of out-migration are only significantly higher for those with the highest levels of education. The findings related to age, education, and previous migration experience are however consistent with most migration research, which indicates that out-migration is selective in relation to life cycle, education, and social networks that provide information on the migration experience.

The descriptive results together with the model findings provide little evidence to support the idea that indigenous households use out-migration as a livelihood diversification strategy. Descriptive results indicate that accompanying a spouse or relative is by far the most commonly reported reason for migration among both men and women. Work reasons were listed as the reason for migration for just 21% of men and there was no influence of the household and community natural capital assets on out-migration, suggesting no push factors related to resource availability or the prospects of a natural resource-based local livelihood. Thus, among the indigenous populations for this study, there seems to be little support for the idea that out-migration is a calculated economic decision made at the household-level as posited by the livelihoods framework and particular migration theories.

The finding related to the presence of oil companies provides an interesting and important link between the non-farm employment results and the out-migration results. Among men, local oil company activity decreased the odds of out-migration, suggesting that the oil companies serve as an important source of work and decrease the need to go looking for work elsewhere. Furthermore, this suggests that in addition to providing livelihood diversification opportunities for the indigenous, oil companies are also encouraging some young men to stay in their rural origin communities rather than out-migrate. While it is not measured in this survey, it is also possible that the local oil companies are attracting young indigenous men from other rural communities, something that is worth exploring in future research.

CHAPTER 9

Conclusion, policy implications, and limitations

9.1 Summary of key findings

This research sought to examine the determinants of important aspects of change perceived to be occurring among indigenous peoples of the Amazon, principally livelihood diversification in the form of non-farm employment and out-migration. Understanding the ways that indigenous peoples are changing is critical both from the perspective of conservationists who see indigenous lands as being a critical barrier to deforestation, and to cultural preservationists aiming to protect and promote indigenous identity, language, and cultural practices. Both non-farm employment and out-migration are already common practices among indigenous households in the Ecuadorian Amazon, and thus the main question driving this research was "What are the individual, household, and contextual factors that lead indigenous households to decide to diversify livelihoods and participate in non-farm employment, or to have a member of the household move away temporarily or permanently?"

This dissertation contributes to the literature on indigenous livelihoods because to date there has not been an explicit focus on non-farm employment or population mobility among indigenous people. Furthermore there has been very little empirical research using quantitative methods focused on indigenous people. This research is among just a small set of studies that have used survey data from indigenous households and communities, and is among just a few studies that examines processes of change across multiple ethnic groups living in the same study area.

The livelihoods framework was used to organize and link the different literature and concepts drawn upon for this dissertation. Different theories drawn from the market integration, migration, and livelihoods literature provided an important basis from which to develop hypotheses for this research, and the modeling approach used in this dissertation allowed for a multivariate examination of the relationship of different types of capital with non-farm employment and out-migration. Different levels of human, natural, social, financial, and physical capital, and other individual, household, and community mediating factors were conceptualized as influencing livelihood decisions, and I hypothesized that the odds of participation in non-farm employment and out-migration would differ in relation to individual characteristics, household and community assets, ethnicity, social relations, institutions, and trends.

In general the results suggest that non-farm employment is a critical livelihood diversification strategy for indigenous households, while in contrast, out-migration either for individual economic benefits, or for livelihood or remittance benefits for households is far less common. The findings indicate support for many of the hypotheses, particularly in those related to education, physical infrastructure in terms of local employment opportunities, and the accessibility of markets for the sale of agricultural products, which as mentioned earlier in the dissertation, were among the only factors cited in the livelihoods literature as being consistently positively associated with livelihood diversification. The odds of both non-farm employment and out-migration increased with education and suggest that education may both be changing livelihood aspirations as well as labor market returns for indigenous people. At the same time, the proximity of labor opportunities, particularly oil companies operating near indigenous

communities, greatly increased the odds of non-farm employment, and at the same time decreased the odds of individuals out-migrating from the community.

There were mixed findings for natural and social capital assets, and no significant findings for financial capital assets in relation to participation in non-farm employment and out-migration. Households with more natural capital assets including larger cultivated areas were less likely to participate in non-farm employment, but this same factors had little or no influence on the amount of time households spent engaged in non-farm employment or the likelihood of out-migration of household members. Social capital factors were only significant in relation to the amount of time that households engaged in non-farm employment, in that households with more social capital spent less-time engaged in non-farm employment, possibly because households with more social capital may be more likely to share work opportunities with other households in the community, taking turns at tourism and oil company work. Also important was the influence that a previous migrant from the household had upon the odds of migration of other members of the household.

There were also mixed results for individual and household mediating factors such as age, gender, and ethnicity. Particularly interesting are the ethnicity results which indicate the diversity of livelihood diversification strategies among the ethnic groups even when controlling for other factors. This finding is in contrast to past findings related to land use with the same study population, which found that differences in total cultivated area between the ethnic groups could largely be explained by household and community factors (Gray et al., 2008). The decision to participate in non-farm employment, however, is highly influenced by ethnicity, with the Huaorani and Cofán being the most likely to participate and the Kichwa being the least likely to participate, even when controlling for the proximity of local employment opportunities.

Ethnicity was less important in influencing either the amount of time that households engaged in non-farm employment or the odds of out-migration of a member of the household.

Spatial dimensions of employment are explored to some degree in the descriptive analysis but could be explored further in future analysis exploring individual determinants in addition to household and community determinants. In addition, spatial weights could be used to look at whether the effect of variables is diverse across space.

9.2 Policy Implications

There are several potential policy implications of this research. Perhaps the most important of these is the juxtaposition of these research findings with the traditional narrative of oil companies versus indigenous peoples that is pervasive in popular writing on the current context of oil development in the Ecuadorian Amazon. While this dissertation does not address the historical impacts that oil activity has had on indigenous peoples and their lands since the opening of oil fields in the area in the 1960s, the findings do illustrate the current importance of oil employment for indigenous households and their livelihoods. Oil companies are typically depicted as altering indigenous land uses, polluting local environments, and destroying indigenous cultures and beliefs. The prominence of non-farm employment among indigenous households and particularly oil employment suggests that the current polemic is oversimplified. The prevalence of non-farm employment in the direct vicinity of indigenous communities is providing indigenous peoples with local rural employment and cash, and at the same time is decreasing the odds of out-migration. While it is premature to conclude that oil company activity actually benefits indigenous people and their communities, the findings do suggest that

further study, looking solely at the determinants of oil employment and the influences of oil activity on urban migration, is warranted to shed light on this issue.

An additional policy implication relates to the relationship between natural capital, non-farm employment, and out-migration. Conservationists have long argued about the long-term conservation implications of changing indigenous livelihoods given the importance of indigenous lands for conservation in the Amazon. Furthermore, many conservation organizations are now promoting alternative livelihoods or sustainable livelihoods as a means of decreasing local people's environmental impacts on protected areas. In some cases, forms of non-farm employment, particularly ecotourism or the development of community businesses that add value to agricultural products, are being promoted as substitutes for more extensive agriculture, hunting, and timber harvesting. The findings from this research indicate, however, that agriculture and fishing are still important livelihood strategies, even as hunting conditions have universally declined. Moreover, households and communities with ample natural capital (forest reserves, good fishing, and ample agricultural land), those that conservationists might be most interested in engaging in alternative livelihoods, are less likely to participate in non-farm employment even when local employment opportunities exist. This suggests that conservation initiatives aimed at substituting alternative livelihoods for natural resource-based activities will need to plan carefully to avoid a situation in which those interested in the conservation scheme are only those whose natural resource base is already degraded and not of value to conservation.

9.3 Limitations

While this research has resulted in important new findings related to indigenous peoples, their livelihood diversification, and their population mobility, there are several limitations that

should be mentioned. Some of these limitations suggest the need for caution in the use and interpretation of the findings, while others indicate the need for further research and improved data collection. The first issue that should be mentioned is that while the dataset is unique, in terms of its inclusion of household and community data from 36 communities across five ethnic groups, the initial selection of the communities in 2001 was not random. The principal investigators deliberately chose a diverse set of indigenous communities in order to get a full range of ethnicities from both remote and accessible locations. As such, the generalizability of the results to Kichwa and Shuar communities, should be made with caution since there are many additional communities that were not selected for the sample, and if there is a selection bias, the results could differ for other communities. For the Huaorani, Secoya, and Cofan, however, the number of communities was actually oversampled, and the findings with respect to non-farm employment and out-migration are likely representative of the true situation.

The second issue is that because the data for this research are based on a retrospective cross-sectional survey of households, there were frequent challenges in ensuring that the dependent variable wasn't also a predictor of the independent variables. Information on different bouts of employment was collected for the year prior to the survey, and information on the permanent out-migration of household members was collected for the 11 years prior to the survey. Many independent variables, particularly at the household and community levels, were only collected for the year of the survey. This data challenge can result in endogeneity and inflated standard errors for coefficient estimates for independent variables. As a result, some factors may not appear to be significantly associated with the outcomes of interest when in fact they are. Efforts were made to use lagged indicators so that independent variables would predate the outcome of interest, but in several cases the data were not available. The out-migration

models are particularly subject to endogeneity because retrospective data for the 10 year period were collected for only a handful of variables, and most household and community data were only available for 2001.

Several additional limitations of the migration data were also identified during the analysis. One prominent issue that made it challenging to incorporate a household size or household composition variables in the models of out-migration, was the incomplete information collected on the departure of household members to form their own households within the same community. The departure of these former residents of the household was not recorded on either the household roster or the migration roster. As such, I determined that there was too much error in the time-varying household size variable to warrant inclusion in the person-year database and out-migration models. Rather than rely on incomplete information and introduce error in the models, I chose to omit the household size and household composition variables from out-migration models. Several different specifications could be assessed including, number of children ever born and number of children born at the beginning of the ten-year period, though neither of these will accurately capture how many people lived in the household at the time of out-migration events.

Second, the lack of information on the departure of entire households from the study area limits the generalizability of these results to just the out-migration of members of households still present in the community. There is a strong possibility that the determinants of out-migration differ for households that move as a unit, and this should be a topic for future data collection and analysis. The third issue with the migration data is that the data collected are not ideally suited for event-history analysis. Some information collected on the household roster was not collected for migrants or was collected differently, which makes it challenging to incorporate more time-

varying variables into the discrete-time event-history models. More recent data collection efforts by the principal investigator have been developed with these analysis techniques in mind and yearly data are collected for household size, out-migration, births and deaths, land use, and other important events. These time-varying variables should provide for better data quality and more consistency across migrants and non-migrants.

The final limitation is related to the heterogeneity of the data. The inclusion of the five ethnic groups presents a challenge, because it is possible that the factors influencing non-farm employment and out-migration will be heterogeneous across the ethnic groups. For most groups there is not sufficient data to calculate models of the outcomes for individual ethnicities, but it would be worth examining for the Kichwa and Shuar households or possibly in future analysis if there are more households from the different ethnicities.

Similarly, this research did not look closely at spatial heterogeneity that might exist across the study area in the determinants of non-farm employment and out-migration. While spatial variables measuring various aspects of accessibility were included in the models, further spatial heterogeneity may exist across the wide study area and could be explored in future analysis using spatial statistics.

There is also additional heterogeneity within the measures of non-farm employment and out-migration than demands further research. The models that were specified for this research aggregated various types of non-farm employment and outmigration, and future models could look at narrower specifications according to employment type, reasons for migration, or migration destination. In particular, multinomial models of out-migration according to the destination of migrants might provide more insight into whether different factors influence rural

versus urban migration. Similarly, non-farm employment could be specified differently to explore differences in factors influencing oil employment versus other types of employment.

All of these possible avenues for further research will be aided by the recent collection of a second round of data in the same indigenous communities by Gray and Bilsborrow. The new data collection, completed in 2012, addresses most of the limitations noted here, and will greatly enhance the study of out-migration. Gray and Bilsborrow rely on a retrospective life-history method that is more specifically suited to event history analysis. They also sought to better track all members of the original households, thus adding new households that were formed by children to the sample, and resolving the issue of lost household members as they move out to form their own household. The new panel data should also eliminate most of the issues of endogeneity because the characteristics of households in 2001 can be used as independent variables related to migration between the 2002 to 2012 period. In general, there are many new possibilities for future research on the land use, livelihoods, and population of mobility of indigenous peoples, and my findings will serve as just a first step in a promising body of future research on the topic.

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