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Remittance and Migration: Impact on Technology Adoption, Natural Resource Conservation, and Household Welfare

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REMITTANCE AND MIGRATION: IMPACT ON TECHNOLOGY ADOPTION, NATURAL RESOURCE CONSERVATION, AND HOUSEHOLD WELFARE

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First and foremost, I dedicate this thesis to my Lord Jesus Christ, for giving me the strength to see this thesis through.

I also dedicate this thesis to my parents for their loving support and encouragement through the most difficult of times.

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PREFACE

This thesis is the result of a collaborative effort to study and promote sustainable food systems. I wrote for and was awarded the U.S. Borlaug Fellows in Global Food Security Graduate Research Grant in 2012. Under the guidance of my thesis advisor, Professor Krishna Paudel, I designed a survey to collect both qualitative and quantitative data. It was adopted from two surveys: one conducted by the University of Guadalajara and Princeton University and the other conducted by the University of Michigan in Nepal. During Jan-May (2013), I lived in Nepal, participating in all aspects of life. I conducted informal interviews with those who could speak and understand English, and collected material on resource use and property rights. Five Nepalese research assistants interviewed households in Nepali and translated the responses into English, so the detailed activity, income and expenditure data were obtained from 396 households over a two-month period. Under the guidance of Professor Paudel and two others, Professor Biswo Poudel from Kathmandu University and Dr. Dilli K.C., CYMMIT South Asia Regional Office, econometric models were used to explore different household livelihood strategies. I wrote the manuscript included in this thesis, and a version of Chapter 3, 4, and 5 will be submitted for journal publication.

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2SLS	two-stage least squares
3SLS	three-stage least squares
CA	conservation agriculture
CYMMYT	International Maize and Wheat Improvement Center
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GON	Government of Nepal
NARC	Nepal Agricultural Research Council
NARI	National Agricultural Research Institute
NELM	new economics of labor migration
NGO	non-governmental organization
USAID	United States Agency for International Development
VDC	Village Development Committee

ABSTRACT

Nepal is the perfect country to study all the facets of migration, sustainable agriculture and their subsequent impact on food systems. Droves of migrants are leaving rural Nepal for higher incomes to cover household daily expenses. The Government of Nepal (GON) encourages migration as a means to reduce poverty, and remittance already amounts to 25.83% of GDP, and it is expected to grow (Nepal Bastra Bank 2014, Thieme and Wyss 2005, Yang 2011). However, it is still unclear whether the mass exodus from rural areas and the growing dependence on remittance, the portion of the migrant workers' earnings sent back to the migrant's family, will exacerbate food insecurity in the long run. For migration and remittance to foster sustainable development, this non-labor income has to eventually be channeled toward productive investments.

The most obvious use of remittance income that could foster economic growth in rural Nepal is to finance inputs that increase agricultural productivity. Agricultural development has been the crux of many national and international development proposals; it is considered the main objective in U.S. Government initiatives such as Feed the Future by USAID (Nepal FY). However, increasing economic growth through agricultural development should be weighted by the potential environmental degradation (Frost et al. 2007). Otherwise, increasing agricultural productivity may exacerbate food insecurity problems (Mgbenka et al. 2012). The impact of migration and remittance on agricultural productivity and natural resource conservation may also be accelerated by the simultaneous investment in education.

This study separates the impact of migration and remittance on several household investment decisions using three stage least squares (3SLS) on new data collected from representative households in eastern Chitwan (Feb-Mar 2013). Testing whether migration and remittance as an overall positive effect on technology adoption, natural resource conservation, and household's per child expenditure on education enhances our understanding of how Nepalese households' decision-making process, and their use of remittance income, impact sustainable poverty alleviation and food security. While several studies on international and domestic migration have been carried out in Nepal, to date, there has been little published on its impact on sustainable food systems in the Chitwan Valley.

CHAPTER 1
INTRODUCTION

Poverty alleviation programs have long considered the diversity of pathways to Nepal's economic development, but Nepal's economy is still highly agrarian; agriculture accounts for 33% of GDP and provides the livelihood for 75% of the population (Nepal Ministry of Finance 2014, Thieme and Wyss 2005, Maharjan et al. 2012). A quarter of its people live on less than US$1 a day, and Nepal is a food import country, unable to produce enough food to meet the needs for the whole year; consequently, Nepal's successful economic development hinges on increased agricultural productivity (Wagle 2010, Nepal FY). Nepal's Terai, or fertile lowlands, possess the most promising means of attaining self-sufficient agricultural production, and improving the agricultural productivity in Chitwan, one of its most agriculturally developed districts, may be the quickest way to achieving equilibrium in the foreign exchange of food. The *long-term* productive capacity of the valley is indispensible to the future of the nation, and while improving the *sustainable* livelihoods of small and marginal farmers in the area is imperative, landholdings continue to be fragmented and agricultural lands infringed upon—a major challenge, which surprisingly receives little policy attention.

Chitwan's successful agricultural development becomes inherently more complex when growing numbers of farming households are participating in internal (from rural to urban) or international migration (Williams 2009; Nepal's National Population and Housing Census, 2011, Massey et al. 2010). Countries that have transitioned from agricultural based economies, through intensification or diversification, have realized economic development and modernization in the past, but Nepal's agricultural sector, including its most agriculturally developed districts, are still underdeveloped (Frost et al. 2007; Rozelle et al. 2009, Maharjan et al. 2012). The social, institutional, and environmental features of the Nepalese context requires that development initiatives be formulated in accordance with its reality—the most alarming being that migration is leading to increased off-farm employment in an already food insecure country; officials have estimated that two million working age adults have left the country, and the bulk of it has occurred in the last decade (United Nations Population Division, 2011; Lokshin et al. 2010). Studies have also shown that the only thing sustaining its tepid economy is their remittances, the portion of the migrant workers' earnings sent back to the migrant's family in cash or in kind, which already amounts to 25.83% of GDP, and it is expected to grow (Nepal Bastra Bank 2014, Thieme and Wyss 2005, Wagle 2010, Yang 2010).

The remittances may be flowing in response to the country's macro-economic performance, frequent natural disasters, or recurring political conflict, which may be helping its rural households diversify income sources and smooth consumption levels in response to shocks—when households face repeated crop failures, for example, they may have strong extended family systems that can ensure continuous remittances in order to prevent deprivation (Quinn 2009, Ratha and Silwal 2012). Other studies suggest that in addition to improving the farming households' financial means, migration may also be expanding the family's skill base and social networks, fundamentally influencing the socio-economic development of the migrant, household, and eventually the community and nation. While many agree that the institution has the potential to increase food security, alleviate poverty,

and promote development, especially for the rural poor who are isolated, under-educated and lack the means to win greater access to local resources, many others warn that remittance receipts may not *sustainably* alleviate poverty and improve food security in the long run; it could actually be leading to a growing dependence on an non-labor income, with very little of it being channeled toward economic development (Thieme and Wyss 2005, Wagle 2010, Carletto et al. 2011, Lez-Vega et al. 2004, Frost et al. 2007, Yang 2011, Adams and Page 2005, Ratha and Silwal 2012, Grigorian and Melkonyan 2011).

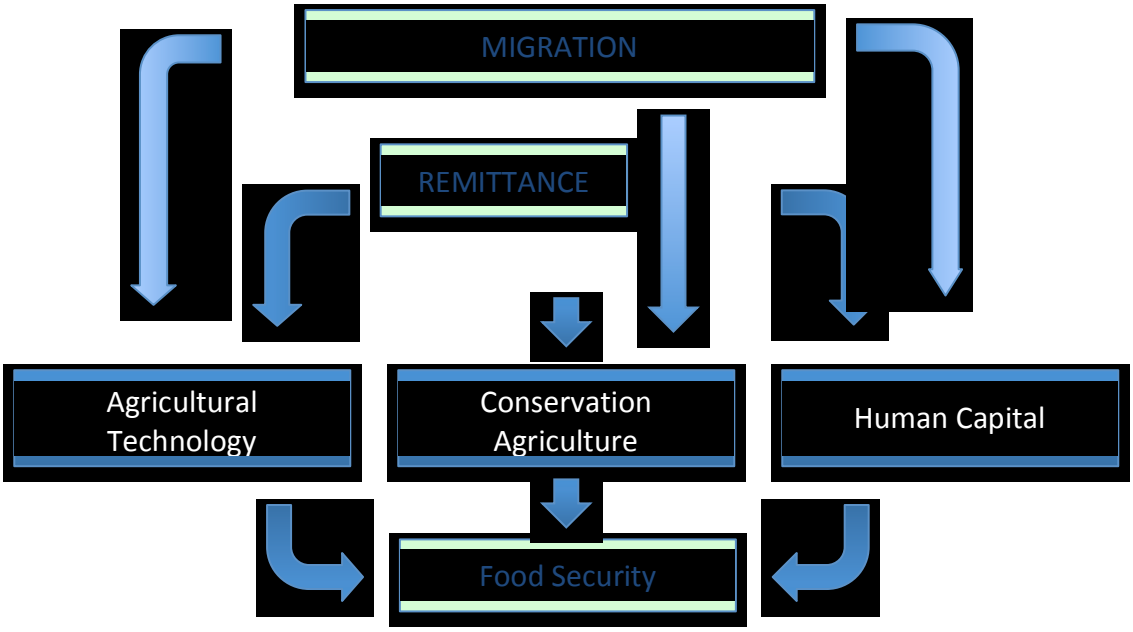

Figure 1. Potential impact of migration and remittance on sustainable food security.

While previous research suggests that remittances have helped a significant number of households in the developing world *cope* with vulnerabilities to shock, sole dependence on remittances has also produced moral hazards, or disincentives to work (Grigorian and Melkonyan 2011). Previous studies have additionally shown that the sudden death of a migrant, their propensity to remit lesser amounts over time, and negative shocks to exchange rates may all lead to deleteriously consequences for the recipient household; furthermore, remittance receipts are not always predictable, and households may find it difficult to manage the money, all indicating these households *continued* exposure and vulnerability to risk and uncertainty (Thieme and Wyss 2005, Yang 2011, Frost et al. 2007, Grigorian and Melkonyan 2011). Considerable research is still required to fully understand the long-run implications of migration and remittances for this small, landlocked country; and while their expenditure on consumption may be important—they are starting at very low consumption levels—their successful livelihood outcome is related to *improved resilience* to food insecurity, which is fundamentally related to agricultural productivity, the sustainable use of natural resources and education levels in Nepal (Nepal FY).

A multifaceted problem, such as this, requires bringing together multiple stakeholders from NGOs, research institutions, and extension workers; this thesis hopes to make a contribution by helping formulate the pathways to sustainable food systems, and in order to take into consideration the Nepalese context and endogenously derive these pathways, a researcher lived in Nepal during Jan-May (2013). By participating in all aspects of life and living through an agricultural season, it confirmed that Nepalese desire livelihoods, and adopt strategies that are deeply influenced by the context in which they live. These informal interviews clarified a wide range of social and economic features of the society, such as resource use and property rights. Additionally, Nepalese research assistants obtained the detailed activity, income and expenditure data for 396 households over a two-month period in order to ascertain the link between food systems and migration from the eastern Chitwan Valley. By tackling this problem in Chitwan, located in south-central Nepal, we hoped to contribute to the sustainable food security of numerous households in the valley, but ultimately determine trends and make policy suggestions that could help subsidize the crippled farming systems in other more vulnerable areas of the country, like the Western Development Region.

Source Nepalnews.com

Figure 2. Map of districts in Nepal

Studies on factors influencing adoption of agricultural technology, natural resource conservation, and children's education have been conducted before, but to date, there has been little published on the impact of migration and remittance on these investments in the Terai—understandably, food insecurity is overtly concentrated in the hilly areas, but the investment in the above stated outcomes are inherently linked to the country's sustainable agricultural development (Nepal FY). Additionally, we present empirical evidence using primary data from a region of the Terai that has not been previously studied—the magnitude and

intensity of factors leading to investments have varied from one place to another based on the agro-ecological, socio-economic and institutional settings. We proffer that migration and remittance have both positive and negative effects in eastern Chitwan, and if regulations and policies are not coupled with recent evidence, migrant remittances may be used mainly for consumption, with very little being used for sustainable investment or worse, may contribute to the degradation of an already vulnerable environment and/or further marginalize lower-caste and ethnic groups in the country (Maphosa 2007, Lez-Vega et al. 2004).

Thesis Organization

The thesis is presented to allow readers at different levels to quickly locate areas of interest, and it is organized into six parts. Following the introduction, the literature review related to the three essays in this thesis will be presented. The new economics of labor migration (NELM) has various applications connected to agricultural development and a broad overview of previous literature related to the Nepalese context is reviewed. There are journal style manuscripts on technology adoption, natural resource conservation, and children's education, presented in Chapter 3, Chapter 4, Chapter 5, respectively. Each manuscript includes an introduction, data and methodology section, which discuss previous work, economic theory, model, variables and the estimation procedure used. The results section discusses the impact of migration and remittance on the particular variable of interest. The last two sections of each manuscript summarize the results and conclude with limitations and suggestions. Chapter 6 presents a general overview of the results and conclusion of the migration and remittance study in Nepal.

CHAPTER 2
LITERATURE REVIEW

The theoretical framework for this study is the new economics of labor migration (NELM), which suggests that migrant households, households with at least one member who has left for work, represent an institution influenced by risk and uncertainty (Rozelle et al. 1999 citing Stark 1991 and Taylor et al. 1999). For example, most rural households in developing countries, like Nepal, are farming households; they can represent a large percentage of a developing country's total population, which means many of them are fully employed in livelihood activities throughout the year, undertaking subsistence agriculture, cultivating every bit of land to support their family (McCalla et al. 2010, Rozelle et al. 2009, Mendola 2007, Maharjan et al. 2012). However, "adverse weather conditions and structural limitations such as small land holdings, lack of basic infrastructure, and mechanization, constrain productivity and hinder the commercialization of products" (Maharjan et al. 2012). Because rural households have less secure access to income, credit and time constraints, so that any new endeavor has to compete with established livelihood activities, they are often unable to withstand, adapt, or react to shocks, associating rural agriculture with poverty (Lez-Vega et al. 2004, Mendola 2007, Frost et al. 2007).

Furthermore, the country's political instability and corruption may impede the building of much-needed infrastructure, which means an indeterminate amount of time associated with poor access to credit, insurance markets, and government services, such as health clinics, education, roads, and a reliable electricity grid. Domestic labor markets are usually crippled—there may be several contractual and oppressive institutions regulating it or it may still be largely dependent on the agricultural sector—where labor participation varies with the time period of the year (Lez-Vega et al. 2004, Thieme and Wyss 2005, Mendola 2007, Rozelle et. al 2009, Wagle 2010, Massey et al. 2010). Ultimately, underdeveloped countries fail to provide resources or incentives for their poor, unemployed and/or underutilized people to remain in their communities of origin, and as the population continues to increase and the shortage of employment opportunities persist, people may adopt out-migration in order to cope with risk and uncertainty (Grigorian and Melkonyan 2010, Frost et al. 2007, Firdaus and Ahmad 2010, Wagle 2010). Currently, there are over three percent of the world population living outside their country of birth and many more that have moved out of rural areas (United Nations Population Division, 2013).

Farming households in the western region of Nepal, for example, are located in the larger dominant economic and political system centered in the capital, but they typically have to work with imperfect developing markets for input, product, credit, and insurance, which function sporadically if they exist at all (Wagle 2010, Maharjan et al. 2012, Mendola 2007). There are social and cultural complexities that control many aspects of their lives in addition to severe constraints they face that stem from marginal conditions for most forms of agriculture (Thieme and Wyss 2005, Mendola 2007). For example, political instability and the ensuing violence has become a pervasive feature of their environment, and land erosion, flooding, deforestation and other natural calamities further exacerbate the situation (Agrawal and Gupta 2005, Massey et al. 2010, Maharjan et al. 2012). As previous studies have suggested, "households that depend primarily on agriculture, either because they farm or

because wages on other people's farms comprise a large part of their income, tend to be mired in poverty" (Lez-Vega et al. 2004). Fortunately, Nepal's macroeconomic functioning could affect its rural households' production behavior, but political instability has resulted in many people leaving the area before substantial improvements can be made (Thieme and Wyss 2005, Lokshin et al. 2010)

Many Nepalese are deprived of the choice and potential success of a livelihood strategy in their communities of birth, and research may support several economic reasons that help explain why one would migrate to a new area including altruism, environmental degradation, discrimination, corruption, illiteracy, credit, loan repayment, and investment (Thieme and Wyss 2005, Quinn 2009, Stark and Lucas 1988, Massey et al. 2010, Yang 2011, Carletto et al. 2011, Laia et al. 2012). There is a rigorous effort to quantify the relative importance of different motivations to migrate, but Massey (et al. 2010) explains that the "critical determinants of migration fall into three basic categories: human capital, social capital, and physical capital." The problem is that studies on motivation have a tendency to focus on only one dimension of migration in isolation from all others (Massey et al. 2010, Rozelle et al. 1999). As the NELM stresses the interrelationship between the motivation to migrate and the impact of migration, it is imperative that the research community also make clear the uncertainties concerning some of the benefits and pitfalls of migration for rural economies; in some cases, it is more important to side step the question of motivation and delve into the ramifications for family operations when households experience the loss of labor (Rozelle et al. 1999).

One such consequence of out-migration, a male dominated institution, is the "feminization of labor" (Maharjan et al. 2012). When men migrate for work, women must take on a larger share of household and agricultural responsibilities (Laia et al. 2012, Thieme and Wyss 2005). Traditionally, males performed heavy farming tasks while females did lighter agricultural work, but traditional rules are no longer strictly observed resulting in unclear gendered activities (Maharjan et al. 2012). The growing availability of female labor or female-headed households, due to out-migration, does little to prevent households from facing labor shortages during peak agricultural seasons, especially if crop production is labor intensive. Significant lost-labor effects inhibit the intensification and diversification of agricultural production, the fundamental instrument for reducing food insecurity in many poverty alleviation programs. Out-migration also has the potential to create moral hazards (Nepal FY, Frost et al. 2007, Rozelle et al. 2009, Maharjan et al. 2012, Grigorian and Melkonyan 2011). "Often overlooked are the loss of productive labor for the home country as well as the potential disincentives to work, study, and stay in the home country for the family members left behind" (Grigorian and Melkonyan 2011).

Another example of a lost-labor effect is food insecurity. The Western Development Region, the most impoverished area of Nepal, for example, is linked to the national economy through prices of agricultural inputs, but the region continues to receive minimal government-provided infrastructure, such as all-weather roads, public irrigation, and safe drinking water, which is creating disparities among regions and weakening the incentives for households to stay in the area (Massey et al. 2010, Wagle 2010). As larger shares of farming households participate in internal and international migration, the most vulnerable region of Nepal continually experiences negative growth in agriculture, partially explained by out-migration (Wagle 2010, Maharjan et al. 2012, Lokshin et al. 2010, Thieme and Wyss 2005). Formidably,

there still remain a large percentage of rural households that still depend on agriculture with most of them unable to produce enough food to meet the daily minimum calorie requirements—food insecurity in the Western Development Region has become an important focus area in U.S. government initiatives such as Feed the Future by USAID (Thieme and Wyss 2005, Wagle 2010, Nepal FY).

On the other hand, migrant households are very likely receiving a major injection of cash; the amount of remittances depends on the status of the migrant (legal or illegal), salary, living costs, and the makeup of the migrant family (Thieme and Wyss 2005). Officials estimate that 375 billion nominal dollars flowed to the developing world in 2011, and made up to 31% of a country's GDP, making remittances the most important source of private capital flows to more than a dozen countries, including Nepal (Ratha and Silwal 2012). It has exceeded official development assistance and portfolio investment since the 1990s, and it now approaches foreign direct investments (Yang 2011). Unlike other forms of aid, remittance-recipients usually do not have an obligation to repay, and "at the household-level, these remittances are likely to have important income effects, as well as possibly relax binding liquidity, credit, or insurance constraints" (Carletto et al. 2011). The extra income can be used for several purposes: it can facilitate investment, for example, starting new micro-enterprises or if the role of public policies and labor markets are negligible, the extra income affords rural households the means of securing daily food requirements and escaping poverty (Mendola 2007, Yang 2011, Frost et al. 2007, Carletto et al. 2011, Thieme and Wyss 2005).

The literature is now inundated with the migration and remittance effects on outcomes such as poverty, inequality, health, education, investment, savings, labor supply, labor participation, and economic growth. However, the literature suggests mixed results. Some studies find that migration and remittance have a positive effect (Quinn 2009, Adams and Page 2005, Lokshin et al. 2010, Carletto et al. 2011), others suggest no or limited effect (Bansak and Chezum 2009, Lez-Vega et al. 2004), and some find a negative relationship (Rozelle et al. 1999, Wagle 2010, Grigorian and Melkonyan 2011, Adeola et al. 2011, Maharjan et al. 2012). "While most studies find that remittances boost consumption, results vary as to how much of the remittance flows get siphoned away for more productive uses" (Grigorian and Melkonyan 2011). For migration and remittance to foster sustainable development it has to eventually be channeled to investments, and the most obvious use of remittance income that could foster economic growth in a food insecure country like Nepal is to finance inputs that increase agricultural productivity. However, an obstacle to gaining insight into household consumption and investment behavior in Nepal is data quality—official figures are still unable to capture the scale of migration taking place within and around the country (Thieme and Wyss 2005).

One challenge that analysts may face is the operational definitions of migration—migrants may be delineated in several different ways, by time spent away, destination chosen, or links to the household remaining behind, it all depends on the survey (Carletto et al. 2010, Yang 2010). Migrants may also obtain permanent or temporary jobs—seasonal, circular, and commuting—but researchers have also defined temporary migration in various ways (Yang 2011). We found that individuals commuting from rural areas to participate in the local wage market, for example, were not really engaged in "local" employment—some wards, or neighborhoods in Nepal, are so isolated by distance, bad roads, or weather (monsoon season),

that local wage earners might as well be labeled permanent migrants because they rarely visited the homestead. To further complicate migration analysis, internal migration is "institutionalized" or so common in this country that some households do not consider those who participate in it a migrant or the money they send back remittances (Thieme and Wyss 2005). Remittance indicators may also be subject to measurement error—some households may understate their true income or feel uncomfortable revealing the amount of remittances they receive (Grigorian and Melkonyan 2011).

Moreover, a migration module may not fully capture the spatial dimensions of migrant households, taking into consideration the social ties and specific cultural identities of their communities, so a *migrant household* may be defined in several ways (Carletto et al. 2010, Grigorian and Melkonyan 2011). For example, we found that our stratified random sample of landowners was unable to capture the network of relationships between households that shared common pool resources—households that have close relatives abut their property. The extended family systems may be leading to multi-household consumption and investment decisions, thereby making the study of single-family households administratively simple but inappropriate for the Nepalese context. It was also observed during field study that the head of households did not consider married daughters children—some did not volunteer information about these relationships. The association with a migrant, especially of children, greatly increases the odds of out-migration due to increased information flow, assistance with employment opportunities and help with accommodations—the number has also been used as an instrument to identify a migration equation (Thieme and Wyss 2005, Wagle 2010, Massey et al. 2010).

Another challenge facing the research community is interpreting migration patterns in light of Nepal's ethnically diverse and complex society—accurate interpretation of a socio-demographic variable, such as caste, is a crucial tool in the fight against poverty—researchers have suggested it partially explains the choice of livelihood strategy. However, in order to simplify the analysis, researchers have often sub-divided the 100 different castes and ethnic groups into five to seven categories (Williams 2009, Wagle 2010, Massey et al. 2010). We suspect that the subdivision is an over-simplification of reality; especially after *Nepali* research assistants operationally defined only two castes as "high". One explanation is that lower-caste households historically have had better access to landholdings in the Himalayan foothills and ridges, while higher-caste households, with more choice and flexibility to migrate, had their landholdings in the fertile lowlands, which is located in the southern belt of the country (Maharjan et al. 2012). How each caste ranks may be highly contextualized because of limited internal mobility in the past, so conducting a study in one district may not be comparable to studies in a neighboring district, if composed of people with different ethnic backgrounds (Massey et al. 2010).

Despite the challenges, a serious evaluation of the migration and remittance effects on sustainable food systems in Nepal is required; a large percentage of rural households still depend on agricultural, with too many of them unable to produce enough food to meet the needs for the whole year, so one poverty alleviation strategy that has been advocated is for households to find employment in the Terai—avoiding the low returns to agriculture in the hills and mountains (Thieme and Wyss 2005, Wagle 2010, Nepal FY). This approach is often connected to international migration, as the latter may be the only way to finance internal

migration to the lowlands—Nepalese have a long history of seeking employment in India, and it remains the destination for most of these migrant households, but other destinations are also chosen.[1] Still, households with more choice and flexibility are better able to take advantage of the higher wage rates in the valley, and when an important income-earning opportunity is partially explained by socio-demographic variables, there may be grave implications for households left behind, which has previously been alluded to. Additionally, it may have a significant impact on the fertile lowlands receiving the migrants (Thieme and Wyss 2005, Maharjan et al. 2012, Wagle 2010, Massey et al. 2010).

The Terai, an impenetrable and savage jungle at the turn of the 20th century, was originally opened up for settlement through extensive deforestation efforts—the Government of Nepal's (GON) population distribution policy to overcome food shortages in the hilly areas. The Terai is now the breadbasket of Nepal, and unlike the hills, which can experience gradients of over 30 degrees, the soil is rich and flat, conducive to growing specialty crops like mustard and traditional crops like rice, wheat and maize. However, most of the agricultural production is still characterized by small farm sizes and low levels of agricultural productivity—returns on the cultivation of cereal crops are comparatively low, and most households still depend on them for survival. A growing number of families are also using fisheries and livestock production, such as poultry and dairy farming, to earn cash. Usually a share of total farm production goes to personal consumption, and surplus crops are sold to cooperatives or distributors within or near the local markets.[2] While land is the link to the most fundamental economic activity for the majority of the population, households still lack the level of production required to meet Nepal's food needs for the whole year (Massey et al. 2010, Mendola 2007, Maharjan et al. 2012).

However, Chitwan, located in south-central Nepal, is one of the most agriculturally developed districts in the Terai—with the capacity to contribute a larger share of production and lead the country to self-sufficiency. If carried out appropriately, improved agricultural productivity in this valley could augment farm income, generate employment, ensure food security, reduce poverty, and overall, promote economic development for the entire nation (Firdaus and Ahmad 2010). Yet, with the proliferation of investments in not only agriculture, but also government services, businesses and commercial enterprises, economic opportunities outside of farming have been improving for a number of households. The district has already become the hub for the entire country—a paved road connects the valley to the capital and the rest of the nation—there are plans to expand the airport and there were discussions about moving the capital city to Chitwan, further connecting rural livelihoods to urban markets. On one hand, the excessive urbanization means growing numbers of households are earning rental, employment, and business incomes, but on the other, land is quickly being diverted from agriculture production to real estate, commercial buildings and other physical structures (Massey et al. 2010).

[1] There has been an official open border between Nepal and India with the signing of the 1950 Treaty of Peace and Friendship (Thieme and Wyss 2005).

[2] Because most of Nepal's agricultural produce is wasted due to poor storage and processing, the question of storage, processing, and transporting surplus crops to more vulnerable areas is still a policy concern and should be simultaneously addressed; however, it is beyond the scope of this thesis (Nepal FY).

The capacity of farming to provide the sole means of survival is diminishing fast—the valley is facing severe constraints on agricultural resources; for example, the decline in per capita availability of agricultural land is resulting in alarmingly high land prices. Additionally, many people still lack the appropriate education and social capital to access good local jobs—with already limited numbers of employment opportunities, due to political instability and a crippled labor market, a growing number of rural households are participating in out-migration (Maharjan et al. 2012, Thieme and Wyss. 2005, Massey at al. 2010, Williams 2009). The mass exodus from the most agriculturally developed district in Nepal, resulting in the outflow of resources, may not ameliorate the pressure but exacerbate the growing demand for food and intensify the foreign exchange disequilibrium arising from food imports (Rozelle et al. 2009, Kolawole et al. 2012). The neoclassical model of labor supply suggests that remittance, a non-labor income, may decrease hours *devoted to farming*, so there may be significant lost-labor effects in Chitwan—the local farming system still provides the most important source of economic activity for the valley, and the migrants who are leaving for urban centers, like Kathmandu, and international destinations, like Europe and the United States, may be the most skilled or educated (Williams 2009).

On the other hand, the potential effect of migration on production constraints is not always negative—migration could act as insurance to mitigate risk associated with commodity production (migrant sends remittance in case the crop fails), which means the number of migrants may be positively associated with the adoption of agricultural technology (Quinn 2009). Previous studies have also found that a major constraint to purchasing agricultural technology, such as improved seed, fertilizer, pesticides, farm implements and farm machinery, is the lack of credit (Frost et al. 2007, Akteruzzman et al. 2008, Alam et al. 2008, Firdaus and Ahmad 2010, Maharjan et al. 2010, Mgbenka et al. 2012, Okafor and Fabiyi 2011, Quinn 2009). Migrant remittances could play a significant role in financing these productivity-enhancing technologies. Previous studies have also found that the loss of labor is negligible if the vast majority of migrants were not very active in agriculture before their migration (Rozelle et al. 2009, Thieme and Wyss 2005). So while migration may have a positive or negative effect, and the sizeable flow of remittances could encourage imports and discourage exports of agricultural commodities, the overall impact of migration and remittances on adoption of agricultural technology remains unstudied in this area (Lez-Vega et al. 2004).

Furthermore, there are social, institutional, and environmental features of the Nepalese context that should also be considered in this poverty alleviation scheme—unregulated migration might have deleterious consequences on the *long-term* productive capacity of the country. First, consider that Nepal has one of the highest Gini indexes in Asia, and many researchers believe it is partially explained by the hierarchal caste system—caste-based discrimination is legally banned in Nepal, but the Terai is already highly segregated in terms of access and possession of local resources, like land (Agrawal and Gupta 2005, Wagle 2010, Maharjan et al. 2012). Once acquiring land holdings in the valley, higher caste families did not sell unless they were in a dire situation, and because Nepali family ties were strong, they sub-divided agricultural lands on an inheritance basis—historically, higher caste families possess a larger share of land holdings in Nepal (Wagle 2010, Maharjan et al. 2012). Additionally, "lower-caste people generally have smaller land holdings" if they have land holdings at all (Maharjan et al. 2012). Because the association between land holdings and

economic and social status exist, inequality may inadvertently be impacting the agricultural system (Thieme and Wyss 2005, Wagle 2010, Maharjan et al. 2012).

Consider the concentration of land holdings—families with larger properties to act as collateral, have better access to institutional credit, which may put them in a better position to finance even more land purchases (Maharjan et al. 2012, Firdaus and Ahmad 2010, Ebojei et al. 2012). The assimilation of small farms by larger landholders may increase their overall income by introducing mechanization and commercialization, but it may further marginalize small farmers who choose not to sell—by lacking bargaining power, for example, small landholders may be required to pay higher prices for agricultural inputs (Firdaus and Ahmad 2010). Additionally, studies have found that the concentration of land through purchase and leasing may result in households owning agricultural land but not necessarily having their homesteads in that community—it was observed during field study that families as far away as the capital city owned agricultural land in Chitwan.[3] Having agricultural land scattered in different locations and/or a stakeholder not living in the community have constrained large-scale production or led to sub-optimal investment decisions, input applications, or decisions regarding cultivation practices in other countries (Firdaus and Ahmad 2010, Laia et al. 2012).

Additionally, many income-generating sources are also indirectly determined by size of landholdings, which in turn further establishes economic status (Firdaus and Ahmad 2010, Wagle 2010). It starts with the possession of land—economic power, without which it is difficult to secure a good education, nonagricultural job, or send offspring abroad due to credit constraints (Lez-Vega et al. 2004, Lokshin et al. 2010). While the Hindu caste system reserves the more well-paid and respectable jobs for higher caste people, the marginalized and lower caste households have generally faired with smaller landholdings, lower levels of education and less income (Thieme and Wyss 2005, Wagle 2010). Not all households in Nepal are able to afford the related expenses of migration, especially to international destinations, which means households with more land are in a better position to receive more remittances—further driving the differentiation between wealth groups and further perpetuating caste-based discrimination (Laia et al. 2012, Thieme and Wyss 2005, Massey et al. 2010, Wagle 2010). "The largest increase in the incidence of both domestic and international remittances is registered among households with two and more hectares of land" (Lokshin et al. 2010).

Moreover, the differential access to land, education, good employment, and migration may not only be perpetuating the caste-based discrimination but simultaneously effecting the agricultural system—there are inherent disadvantages facing lower-caste and ethnic groups in their access to certain resources and livelihood strategies, and while many inequality-reducing initiatives are underway, discrimination is still deep rooted in society with many initiatives being thwarted. For example, more privileged families are able to pay less property tax or draw less attention to their large landholdings by simply sub-dividing their land to children and other relatives but maintaining control of its operation. Additionally, these families may have strong networks of relationships that control many aspects of rural life, so even when lower-caste households breach the barrier to land ownership or find the collateral to finance migration, it is not certain that their decision-making process and modes of production are conducive to agricultural development—for example, they may not have the education levels associated

[3] We were unable to survey households who were absent at the time of survey collection.

with higher adoption rates, as evidenced by the poverty alleviation programs that have achieved limited success in the western hills (Wagle 2010, Maharjan et al. 2012, Nepal FY).

So to the extent that migration and the subsequent remittances contribute to higher education levels, technology may be better disseminated, understood and adopted, positively impacting the agricultural system in the valley—studies have shown education is associated with higher adoption rates (Thieme and Wyss 2005, Laia et al. 2012, Mgbenka et al. 2012, Firdaus and Ahmad 2010, Okafor and Fabiyi 2011, Ebojei et al. 2012, Ahmed and Rayhan 2012, Bansak and Chezum 2009, Carletto et al. 2009). Additionally, better access to education and greater use of educational opportunities may not only improve adoption of technological innovations but also increase agricultural efficiency (Pudasaini 1983). "Output growth is not only determined by technological innovations but also by the efficiency with which available technologies are used" (Laia et al. 2012). However, it remains unclear whether the increase in education levels is homogenous; as per capita income continues to rise due to migrant remittances, education levels may disproportionately increase for more privileged households, problematic when promoting agriculture, through the viable management of small and marginal land holdings, is imperative to the socio-economic transformation of Nepal (Nepal FY, Alam et al. 2008, Maharjan et al. 2012, Firdaus and Ahmad 2010).

So while research confirms that households are using a large portion of remittances to educate their children, it should not be expected that this livelihood strategy has gradually spread to the more disadvantaged society members (Thieme and Wyss 2005, Adefila 2012, Mendola 2007, Frost et al. 2007, Nepal FY). Additionally, with growing numbers of households choosing to allocate a significant portion of their labor force to migration and education levels rise, they may be dissuaded them from participating in commodity production at all. There is evidence to suggest that landless households may only have a "precautionary demand" for agricultural land, which is purchased to simply *insure* against food insecurity with no intention of farming it (Lez-Vega et al 2004, Gartaula et al. 2012).[4] There is also evidence that young people in Nepal are not really interested in working in agriculture anymore—it is associated with hard work and poverty. So even if remittances allow rural households from all caste and ethnic groups to rely less on children's work, increasing time and finances available for children's education, does not mean rural households will be committed to agriculture—putting Nepal in a vulnerable position due to food imports (Bansak and Chezum 2009, Carletto et al. 2009, Maharjan et al. 2012, Gartaula et al. 2012).

Furthermore, land continues to be associated with social status, so households who are in a financial position to do so, choose to purchase it nonetheless, which means more agricultural lands are being acquiesced to the land rental market—sharecropping (Thieme and Wyss 2005, Wagle 2010, Maharjan et al. 2012, Gartaula et al. 2012). Studies have found significant heterogeneity between family and sharecropping labor, which may be the result of the many financial and structural relationships found within this type of agricultural system (Ahmed and Rayhan 2012). It has also been linked to low adoption rates in other countries. Additionally, the land sales market may pose a problem to sustainable food security—agricultural lands in the valley are being converted to urban housing developments (Massey

[4] While the demand for land used for subsistence agriculture should decline as living standards rise, households are able to acquire land as their per capita earnings increase (Lez-Vega et al. 2004).

et al. 2010, Thieme and Wyss 2005, Maharjan et al. 2012). Migration may be improving the socioeconomic status of a number of households through education levels and off-farm income, but the socio-demographic characteristics of those left to farming—sharecroppers—may be affecting land and water use decisions and infringement on agricultural lands may be leading to sub-optimal agricultural investments (Maharjan et al. 2012, Mgbenka et al. 2012).

Stagnating productivity in Nepal results from inappropriate land use and poor land management practices; low levels of education and infringement on agricultural lands could be hindering agricultural development in Chitwan—affecting the time spent on agriculture, influencing the quality and quantity of water available, altering livestock mortality rates, and modifying the amount of soil nutrients that are available for production (Ahmed and Rayhan 2012, Alam et al. 2008, Firdaus and Ahmad 2010, Frost et al. 2007). Optimistically, many Nepali landowners may be choosing to adopt improved agricultural inputs due to tenure security—provided by the inheritance-based land distribution system. However, the distribution system may also be contributing to the dwindling farm sizes in the country—eighty-four percent of the landholdings in Nepal are already small, so even higher caste families may have less than one hectare of land (Frost et al. 2007, Laia et al. 2012, Maharjan et al. 2012). Land fragmentation, resulting in even smaller landholdings, could further exacerbate the decline in per capita availability of agricultural resources and/or impede the adoption of new practices (Laia et al. 2012, Adeola et al. 2011, Maharjan et al. 2012, Firdaus and Ahmad 2010, Ahmed 2012, Massey et al. 2010).

Degradation of natural resources is also seen as a root cause for stagnating agricultural productivity—Nepal is small, landlocked, and all Nepali households directly or indirectly depend on natural resources, so improving agricultural productivity does not just require a combination of factors comprising the right technology and access to physical inputs, it also requires effectively managing natural resources (Frost et al. 2007, Kolawole et al. 2012). Otherwise, an improperly applied poverty alleviation program aimed to increase agricultural productivity may exacerbate the problem of environmental degradation in an already vulnerable ecology (Mgbenka et al. 2012, Massey et al. 2010). Policymakers should also consider that the effects might be realized over a long period of time—without proper policies and regulations in place the fertile lowlands could be turned into unfertile fields. The conventional farming practices, like shorter periods of fallow land—preventing the soil from naturally regenerating itself—are destroying the soil's supportive ability and resulting in low agricultural outputs. With deteriorating agricultural lands, Nepal requires improved agricultural technologies that increase crop yields but simultaneously supports the productive capacity of its soil and water resources (Massey et al. 2010).

Disturbingly, many technical interventions have already been disseminated to various households, but Nepalese farmers have not adopted them; during field study it was observed that most farmers have *little to no knowledge* of some of the "modernizing" improvements that the National Agricultural Research Institute (NARI) and the Nepal Agricultural Research Council (NARC) suggests has been introduced in Nepal (see Manandhar et al. 2009).[5] Putting this

[5] It should be noted that not even the research assistants, with agricultural backgrounds, had knowledge of these technologies and improvements. Studies should be conducted on both the perspectives of farmers and agriculture specialists, in order to make clear where agricultural knowledge overlaps and where agricultural understanding diverges between these groups.

obvious gap in knowledge aside, the literature provides some insights into factors leading to low adoption rates: the modern techniques required a higher level of technical expertise or it was constantly changing through education and research, lack of material inputs, limited labor, lack of tenure security, and/or ineffective extension agents; all leading to sub-optimal agricultural investment decisions in previous studies (Frost et al. 2007, FAO 2008, Alam et al. 2008, Akteruzzaman et al. 2008, Firdaus and Ahmad 2010, Okafor and Fabiyi 2011, Mgbenka et al. 2012, Adefila 2012). Only when development initiatives succeed in securing greater participation by those most dependent on agriculture, small and marginal farmers, will it be possible to improve the security and sustainability of vulnerable households in this country.

However, most modernizing farming practices and equipment may *not* be economically viable for small and marginal farmers (Firdaus and Ahmad 2010). Consider that households "with small land holdings, low income, poor access to credit, and limited technical capacity simply cannot take full advantage of interventions that are more suitable for large, mechanized farms" (Laia et al. 2012). Additionally, studies have found that agricultural techniques are better adopted when developed by first understanding what drives the farming community's behavior and decision-making processes, so there still remain significant work required to adapt agricultural technology for the Nepalese context. For example, even with the "feminization of labor"—women performing traditional male activities—ploughing is still considered taboo for women to do in Hindu culture; so while female labor is more abundant than male labor, many improved farming equipment and machinery still have not been adapted for women (Frost et al. 2007, Mgbenka et al. 2012, Laia et al. 2012, Ahmed and Rayhan 2012, Maharjan et al. 2012). Fortunately, there exists a cultivation practice that would tackle head-on the poverty trap of poor farm assets, social status, degraded resources, and does not require ploughing.

Conservation Agriculture (CA) is a sustainable and an environmentally friendly management system that includes practices such as minimum tillage, improved crop varieties, intercropping, and the use of cover crops (Laia et al. 2012). It has the potential to mitigate the depletion of soil nutrients, increase crop yields, and conserve soil and water (FAO 2008, FAO 2012). CA practices also makes it possible to insert a high value vegetable crop in the agricultural system by decreasing turnaround times—diversification of agriculture in favor of more competitive and high-value commodities may help overcome the deteriorating condition of small and marginal farmers; the systems maintains their staple base while generating additional income (Nepal FY). Conservation Agriculture (CA), as defined by the FAO, has been introduced in the Terai, but it is not practiced *permanently* because the farmers still plough the land or use intensive tillage practices for rice, in a rice and wheat-based agricultural system; rice farming is part of the culture and many such farming systems are subject to cultural and religious habits, but rain fed small holder agriculture in this country, with significant loss-labor effects from out-migration, may benefit from the widespread use of CA (FAO 2008, FAO 2012, Maharjan et al. 2012).

Optimistically, Nepal's Feed the Future Multi-Year Strategy is trying to utilize CA as part of their country investment plan; however, poverty and mindset has been identified as factors accelerating environmental degradation, suggesting that education must be a predetermining factor in information assimilation and technological adoption of CA among more vulnerable farmers—in hierarchal societies, ruling elites have better access to various kinds of improvements, and technical interventions would not gradually spread to the more

disadvantaged society members unless marginalized groups are specifically targeted (FAO 2008, Nepal FY, Adefila 2012, Mendola 2007, Frost et al. 2007). Studies in socially stratified countries have found that social status is partially responsible for the sustainability of agricultural systems (Alam et al. 2008, Maharjan et al. 2012, Firdaus and Ahmad 2010). However, awareness of CA practices are expected to grow and CA is not labor or capital intensive, so migrant households may choose to adopt them at a greater rate due to the minimal labor requirements (FAO 2008, FAO 2012). With adequate policies to promote CA among small and marginal famers, agricultural development could converge with natural resource conservation, making migration and remittance a catalyst for sustainable agricultural development in rural Nepal.

CHAPTER 3
REMITTANCE AND TECHNOLOGY ADOPTION IN AGRICULTURE

Introduction

Rural areas of the developing world are experiencing widespread internal (from rural to urban) and international migration, and there are several economic reasons provided in the literature to explain the motivations behind it (see Yang 2011, Carletto et al. 2011, Laia et al. 2012, Thieme and Wyss 2005, Quinn 2009, et al. Stark 1988). While there remains a challenge to quantify the relative importance of different motivations, many would agree that migration and remittance decisions are part of an overall household strategy that fundamentally impacts the household and eventually their community. It is imperative that researchers help make clear the uncertainties concerning some of the benefits and pitfalls—migration may have grave implications for agricultural development and subsequently food security, especially for more agrarian-based economies.

The role of migration and remittances, especially from undocumented migrants, remains a fruitful field of research, and to date, there has been little published on its impact on the adoption of agricultural technology in Nepal—the perfect country to study all the facets of migration and the inevitable implications for agriculture. A quarter of Nepal's population lives on less than US$1 a day, and it represents a continent with more than "half of the world's 1.1 billion poor who live in rural areas and depend on agriculture" (Wagle 2010, Mendola 2007). While Nepal's economy is still highly agrarian, the Government of Nepal (GON) encourages migration in the aims to reduce poverty, which means economic opportunities outside of farming have been improving for a number of households and incentives for participating in agriculture have been weakening (Thieme and Wyss 2005, Maharjan et al. 2012, Grigorian and Melkonyan 2011).

The labor-loss effects from out-migration may be decreasing the agricultural productivity for those still dependent on food production—Nepal is a food import country, and the mass exodus from the country may be exacerbating the situation for rural households who already face severe constraints that stem from marginal conditions for most forms of agriculture, like small landholding size and frequent natural disasters (Thieme and Wyss 2005, Wagle 2010, Maharjan et al. 2012, Nepal FY, Yang 2011, Massey et al. 2010). Many of them are also working with imperfect developing markets for inputs, products, credit, and insurance, which function sporadically if they exist at all, with grave implications for Nepal's agricultural productivity—improving the livelihoods of small and marginal farmers is considered the main objective in U.S. government initiatives such as USAID's Feed the Future (Nepal FY).

Furthermore, research suggests that migrant remittances may only be funding higher consumption of non-investment goods, such as food and clothes. While this may be important if households are starting at very low consumption levels, remittance-recipients may become fully dependent on it, which is potentially hazardous for the most vulnerable—the sudden death of a migrant, their propensity to remit lesser amounts over time, and negative shocks to exchange rates may all lead to deleteriously consequences for the households left behind (Yang 2011, Frost et al. 2007, Grigorian and Melkonyan 2011). It may also be a key factor driving

differentiation among wealth groups resulting in increasing inequality (Wagle 2010). And while many would agree that remittance has the potential to alleviate poverty, increase food security and eventually promote development, the literature suggests mixed results. Some studies find that migration and remittance have a positive effect (Quinn 2009, Adams and Page 2005, Lokshin et al. 2010, Carletto et al. 2011), others suggest no or limited effect (Bansak and Chezum 2009, Lez-Vega et al. 2004), and some find a negative one (Rozelle et al. 1999, Wagle 2010, Grigorian and Melkonyan 2011, Adeola et al. 2011).

Despite the weighty implications for the country's agricultural productivity, little is known about the role of migration and remittances on the agricultural practices of resource-poor smallholders, especially in Nepal's Terai—the fertile lowlands with the most promising means of attaining self-sufficient agricultural production. If households participating in migration use the remittance income, which already amounts to 25.83% of Nepal's GDP, to adopt agricultural technology—remittance could help increase agricultural productivity by funding agricultural technology that would otherwise be too costly—migration and remittance may be a catalyst to agricultural development, improving the sustainability and security of numerous households in the country (Nepal Bastra Bank 2014, Quinn 2009, Thieme and Wyss 2005, Mendola 2007, Frost et al. 2007, Lez-Vega et al. 2004, Firdaus and Ahmad 2010, McCalla et al. 2010, Adeola et al. 2011, Ahmed and Rayhan 2012, Laia et al. 2012, Anim et al. 2012).

This micro-level study aims to answer a significant question regarding the impact of an important institution, migration, on the agricultural development of a small, landlocked country with limited agricultural resources—providing for an overly optimistic view fails to provide an appropriate framework for regulation and policy formation for more vulnerable economies. The rest of the paper proceeds as follows. The data and methodology sections discuss variables, model and the estimation procedure used—because the issue of endogeneity in estimating the impact of migration and remittance on various household decisions was frequently mentioned in the literature, we used an instrumental variable approach to account for the selectivity bias. While a researcher lived through an agricultural season in Nepal, a wide range of social and economic features of the society, such as resource use and property rights were clarified—providing the social, institutional, and environmental framework for the study. The results section discusses the impact of migration and remittance on the number of agricultural technologies adopted and we conclude by summarizing the implications and making policy suggestions.

Data

In collaboration with USAID and the International Maize and Wheat Improvement Center (CYMMYT), a non-profit organization that researches sustainable development, we collected cross-sectional data in Nepal during the spring of 2013. Chitwan, a district in the south-central region of the country, was selected based on the sample of the population participating in migration and agriculture dominance. Over a two-month period, Nepali research assistants used a questionnaire designed to collect both qualitative and quantitative data to survey a strata of small, medium, and large size landholders randomly selected from a list of households located in seven Village Development Committees (VDC): Bachhauli, Birendranagar, Chainpur, Jutpani, Kathar, Padampur, and Piple; all located in eastern Chitwan.

The survey was adopted from two previous studies: one conducted by the University of Guadalajara and Princeton University and the other conducted by the University of Michigan in Nepal. The survey captures information about individuals who are present and those individuals who are not present because of migration, and it was first tested during a focus group and modified for appropriate content.

While this sample consisted of 396 households, many did not make decisions about agricultural technology (they leased out all their land) or felt uncomfortable revealing information about caste, a demographic variable that researchers have suggested partially explains the choice of livelihood strategy in Nepal (Wagle 2010, Massey et al. 2010, Williams 2009). Restricting this sample to those who made agricultural decisions in 2012 and answered information regarding caste yields a sample of 346. The data set is useful in that it not only contains family profile: education, health, nutrition, income, assets, and expenditures, but it also includes the household's agricultural activities, such as input use and agricultural output, and off-farm business activities. The data set also contains a number of household and community level variables—consistent with other cross-sectional data used in the literature (Quinn 2009; Grigorian and Melkonyan 2011).

The dependent variable of interest is the number of agricultural technologies that household *i* utilized (I_i) in 2012. It is a discreet variable ranging from 0 to 10, with the average number of technologies adopted by households in Chitwan being 3.8. The choice of variable is consistent with previous research that considers the intensity of adoption; some technologies are presented in a package with several components, which can be adopted together or independently (Feder et al. 1985). Some of the modernizing improvements included in the questionnaire were taken from a report published by the National Agricultural Research Institute (NARI) and the Nepal Agricultural Research Council (NARC) (see Manandhar et al. 2009) that suggested the technologies had been introduced in Nepal. The agricultural technologies included in the survey were the iron plough, animal drawn cart, power tiller, shallow tube well, deep tube well, rower/dhiki pump, and tractor, among others.

Because the issue of endogeneneity in estimating the impact of migration and remittance on various household decisions was frequently mentioned in the literature (Rozelle et al. 1999; Quinn 2009; Grigorian and Melkonyan 2011; Basank and Chezum 2009; Adams and Page 2005; Carletto et al. 2011), we used an instrumental variable approach to account for the selectivity bias. One equation assumes all variables on the right hand side are exogenous, and while a two-stage least squares (2SLS) technique is appropriate for addressing the problem of endogeneity, we were unable to study migration and remittance together. We applied a three-stage least squares (3SLS) technique to estimate migration and remittances simultaneously—so there are an additional two variables which are both explanatory and dependent variables in the analysis: the number of individuals (over the age of 12) from household *i* who left the home in the previous year[6] (M_i) and the average amount of monthly remittances in US$ received by the household in the previous year (R_i). We did not use a dichotomous variable for whether remittance was used to finance agricultural activities (Quinn 2009) due to fungibility reasons—remittances can be used for various purposes.

[6] The age of 12 was selected to capture individuals who would have participated in household production had they lived at home.

The explanatory variables used in the paper consists of vectors X_i, Z_i, and W_i, with variables in X_i being the socio-economic characteristics of the household, such as age of household head, years of education of household head, income, total size of cultivated farm plots operated by the household, the amount of owned land that was leased out, and the number of agricultural infrastructure accessed last year. The vector X_i also includes dichotomous variables indicating whether agriculture is the main source of income, and if the household experienced labor scarcity in the previous year. The vectors Z_i, and W_i are instrument variables that are used to identify both M_i and R_i, but are not correlated with the number of agricultural technologies adopted I_i. The instrument variables explain both M_i and R_i without explaining I_i. The variables in Z_i are the number of migration experiences and the number of households in the community that participate in migration, which was obtained from GON's National Population Housing Census (2011) and the variables in W_i are the number of houses owned by household *i* and whether or not remittances was used to finance land. The descriptive statistics of the variables used in the study are in Table 3.1.

There are expected signs for the variables in X_i. The average age of a household head in Chitwan is 52.7, which may be considered elderly in developing countries; for example, a study of horticultural production in Nigeria suggested that 40 years of age was considered an older farmer (Okafor and Fabiyi 2011). However, we expect age to positively impact the number of adoption; age may indicate the level of farming experience, which has been positively associated with adoption (Adefila 2012). Also, there is evidence that young people in Nepal are not really interested in working in agriculture (Gartaula et al. 2012, Thieme and Wyss 2005). Some studies found that education has a positive effect (Mgbenka et al. 2012, Firdaus and Ahmad 2010, Bansak and Chezum 2009), but it is possible that increased education levels may have a negative impact (Adeola et al. 2011). It may be easier for more educated individuals to use new technologies or it may lead to off-farm income.

We expect income, whether agriculture is the main source of income, hectares of land cultivated, and the number of agricultural infrastructure (such as extension and irrigation) accessed to have a positive impact on the number of technologies adopted. Wealthier and larger landowners may have more resources and the incentives to pay the costs of new technologies (Firdaus and Ahmad 2010; Ebojei et al. 2012; Feder et al. 1985). Some technologies also require complimentary inputs that are acquired through extension, market, and other agricultural infrastructures (Firdaus and Ahmad 2010, Mgbenka et al. 2012, Agrawal and Gupta 2005). We expect the amount of owned land leased out to have a negative effect; as more agricultural lands are acquiesced to the land rental market in Nepal, which is sharecropping, there will be less incentives to invest in agricultural production (Ahmed and Rayhan 2012, Maharjan et al. 2012, Gartaula et al. 2012). Labor complimentary technology such as the tractor, may also be affected by the availability of labor. Most of the landowners in Chitwan produce rice, which still remains a labor intensive activity, even if a tractor is used to plough the land. Labor scarcity has negatively impacted adoption of agricultural technology before (Feder et al. 1985, Acemoglu 2010).

Table 3.1. Technology Adoption, descriptive statistics by household, Chitwan 2013

Variable	Description	Mean	Standard Deviation
Dependent Variables			
Migrants	# of household members who lived away	1.38	1.66
Remittances	average monthly remittances received in US$	190.59	333.03
Technology	# of agricultural technology adopted	3.76	1.50
Exogenous Variables			
Income	average monthly income minus remittances in US$	280.43	637.58
Main Source	agriculture is main source of income (0/1)	0.59	0.49
Age	age of household head	52.86	13.89
Caste	High Caste (base) Low Caste (2) Mongolian (3) Indigenous (4)	2.10	1.22
Education	years of education of household head	5.47	5.08
Male Education	years of education of household males	25.02	13.72
Female Education	years of education of household females	20.04	15.25
Household Size	# of household members	6.46	2.78
Dependents	# of household members under 12 and over 65	1.47	1.39
Owned Land	total # of hectares owned by household	1.13	4.16
Cultivated Land	total # of hectares cultivated by household	0.97	2.65
Leased Out	total # of hectares owned by household and leased out	0.13	1.15
Infrastructure	# of agricultural infrastructure used	7.51	2.64
Water Quality	water quality is bad (0/1)	0.24	0.42
Soil Quality	soil quality is bad (0/1)	0.05	0.21
Labor Scarcity	household experienced labor scarcity (0/1)	0.06	0.23
Instrument Variables			
Experiences	# of migration experiences in household	0.98	1.06
Participation	# of households in the community that participated in migration	944.67	247.26
Houses	# number of houses owned by household	1.14	0.39
Financed	remittance financed land purchase (0/1)	0.17	0.38

Methodology

We have assumed that households make the decision about migration, remittance, and adoption of agricultural technology as part of an overall livelihood strategy. The rationale behind the assumption comes from household behavior in developing countries—rural households are typically influenced by several natural, market, and social uncertainties. These households are generally dependent on agricultural production, which means they are

vulnerable to environmental hazards, such as weather, natural resource degradation, and natural disasters (Frost et al. 2007). They will "self-protect" thereby exercising caution in their production decisions unless there are institutions in place to provide insurance. Poverty is also overtly concentrated among rural households solely dependent on agriculture, and they may not have the available credit to finance investments (Mendola 2007).

Migration could act as an insurance to mitigate risk associated with commodity production (migrant sends remittance in case the crop fails), which means the number of migrants is positively associated with the adoption of agricultural technology. The more migrants a household sends a way, the more agricultural technology the household will adopt because they are able to send back more remittances in case the crop fails. Furthermore, migrant remittances could play a significant role in financing productivity-enhancing technologies—the lack of credit being a major constraint to purchasing agricultural technology in previous studies (Frost et al. 2007, Akteruzzman et al. 2008, Alam et al. 2008, Firdaus and Ahmad 2010, Maharjan et al. 2010, Mgbenka et al. 2012, Okafor and Fabiyi 2011, Quinn 2009). The number of migrants and remittances has been used to test the risk and credit hypothesis before; the conceptual model is adopted from Rozelle (et al. 1999), Quinn (2009), and Grigorian and Melkonyan (2011). It properly separates the impact of migration and remittance on the dependent variable of interest.

First, consider that the household chooses the number of migrants to send out (internal and international):

$$M_i = \beta_o + X_i\beta_1 + Z_i\beta_2 + \epsilon \qquad (1)$$

where X_i is the vector of household characteristics, which includes household demographics, human capital and physical capital variables, and Z_i is the vector of instruments used to properly identify M, and ϵ are the error terms. The individual household is denoted by i=1, 2 ,3, …, n.

Given the number of migrants, they will make the decision on the amount to remit, R. It is determined as:

$$R_i = \alpha_o + X_i\alpha_1 + \widehat{M}_i\alpha_2 + W_i\alpha_3 + \epsilon \qquad (2)$$

where X_i is the vector of household characteristics, $\widehat{M}_i$ is the predicted value from the first equation, and W_i is the vector of instruments to properly identify R.

Finally, the household will choose the number of agricultural technologies to adopt:

$$I_i = \delta_o + X_i\delta_1 + \hat{R}_i\delta_2 + \widehat{M}_i\delta_3 + \mu' \qquad (3)$$

where the predicted values $\widehat{M}_i$ and $\hat{R}_i$ from the first two equations are included in the investment equation. So, the number of individuals from household *i* who lived away in the previous year M_i and average monthly remittances received R_i, are two variables that are both explanatory variables and dependent variables. The three-stage approach equations:

$$M_i = \beta_o + X_i\beta_1 + Z_i\beta_2 + \epsilon \qquad (1)$$

$$R_i = \alpha_o + X_i\alpha_1 + \widehat{M}_i\alpha_2 + W_i\alpha_3 + \epsilon \quad (2)$$

$$I_i = \delta_o + X_i\delta_1 + \hat{R}_i\delta_2 + \widehat{M}_i\delta_3 + \mu' \quad (3)$$

Results

Testing for Endogeneity and Instrument Validity

We formally test for endogeneity, and the results from the Hausman-Wu test support the choice to use an instrumental variable approach. The null hypothesis of exogeneity of migration and remittances in the technology regression can be rejected at the 90% confidence level; the t-statistic on the individual residual variables are 1.80 and -0.67, respectively. However, remittances should not be viewed as exogenous; households with more migrants should receive more remittances. Furthermore, when there is more than one variable being tested for endogeneity, the test is an F-test of joint significance (Hill pg. 421). Other papers have demonstrated the difference in the probit and the instrumental variable approach (see Quinn 2009), and many others have concluded that an unobservable factor influencing the propensity to migrate and remit is correlated with the regression error terms, if modeling household investment decisions, therefore making the probit or OLS estimators biased.

We also test the instruments for validity. A valid instrument must significantly impact $\widehat{M}_i$ and $\hat{R}_i$ and be uncorrelated with the technology regression error term. The tests of joint significance of the instruments in the migration and remittance equations yield an F-test statistic of 22.95 and 10.17, respectively. To reject the hypothesis that the instruments are weak or that the true value of the instruments are zero, the rule of thumb is that the F-test statistic should be greater than 10 (Hill pg. 414). The instruments pass the first condition. We use the Sargan-Hansen test to determine whether the instruments are uncorrelated with the error term, and that the instruments are correctly excluded from the estimated equation. The null hypothesis is that the instruments are valid, and we fail to reject the null for the variable vectors Z_i, and W_i with a chi-square value of 2.20 and 0.52. These result in p-values of 0.14 and 0.47, respectively.

Summary of Results—First and Second Stage

The results of the estimation of equations (1) and (2) are presented in Table 3.2. They are run with robust standard errors, and some patterns of migration and remittance behavior are revealing. As predicted, the number of migration experiences encourages further migration. The coefficient on experience is positive and highly significant. We find that it is the factor that encourages migration the most. This is not surprising; Nepal has a culture of migration, Thieme and Wyss (2005) said it has become “institutionalized”. The association with a migrant also greatly increases the odds of out-migration due to increased information flow, assistance with employment opportunities and help with accommodations (Thieme and Wyss 2005, Wagle 2010). Consistent with the literature, households with more dependents (children and elderly) negatively impact the number of household members migrating, while larger households are sending out more migrants (Grigorian and Melkonyan 2011).

Surprisingly, families with larger properties are not sending out more migrants. Land ownership in Nepal is associated with social status and wealth, and concentration of land holdings to act as collateral, would mean these households have better access to institutional credit, which we expected would put them in a better position to send out migrants. The negative impact of owned land may indicate that larger landowners have access to sufficient income-generating sources in Chitwan, and do not need to send more migrants for economic opportunities outside the district. Land ownership can be a proxy for wealth, which means households with a lot of wealth do not have the incentive to leave (Griogorian et al. 2011). There may be other reasons as well. Consider that larger land owners may need more household labor to cultivate land, especially if the culture of migration creates labor scarcity during peak agricultural seasons. Or the negative sign reflects the hand full of landowners in the sample who owned very large plots. For example, we found one household owned over 60 hectares of land (average is 1.10 hectares), but was removed from the sample as an outlier. The coefficient on owned land is not very large and is only significant at the 90% confidence level.

Table 3.2. Technology Adoption, results of the first and second stage regressions

Migration				**Remittances**		
	Coefficient		Robust Standard Error	Coefficient		Robust Standard Error
Male Education	0		0.01	3.6		2.25
Female Education	-0.01		0.01	2.94		2.07
Income	0		0	-0.04		0.04
Household Size	0.42	***	0.06	-75.88	***	21.41
Dependents	-0.17	***	0.07	31.28	**	15.72
Owned Land	-0.04	*	0.02	5.88		5.55
Caste						
Low	-0.4	**	0.18	116.17	**	51.13
Mongolian	-0.08		0.15	73.81	*	44.19
Tharu (Indigenous)	-0.4	**	0.21	51.81		43.25
Water Quality	-0.43	***	0.16			
Soil Quality	-0.59	*	0.34			
Migration Experience	0.43	***	0.09			
Participate	0		0			
MHAT				186.13	***	35.03
Houses				133.09	**	56.67
Financed				113.44	**	56.84
Number of Observations	346			346		
Chi-Squared	407.12			130.71		

Note: ***, **, and * denote significance at 1%, 5%, and 10% respectively.
R-Square is not applicable in 3SLS

Coupled with our findings of the ethnic composition of households sending more migrants, there could be a more prosaic reason why landholding size in Chitwan does not act as collateral for migration. Other studies found that not all households in Nepal have sufficient income-generating sources; differential access to land is present, with the majority owning small or marginal sized plots (Wagle 2010). We also found that some households do not own land, but rent the land they cultivate. However, we propose that while marginalized and lower caste households have generally faired with smaller landholdings in other parts of Nepal (resulting in limited mobility), there are cultural norms that are driving the decision-making practices of the Tharu or indigenous people that should be accounted for in the migration analysis. They have larger landholdings, but seem to be more attached to their "ancient" landholdings than the people who migrated to Chitwan in the past fifty years. Our study finds that they send fewer migrants than higher caste households. The indigenous population would not migrate even if they had the collateral to do so. However, this excludes the lower caste households that are sending out fewer migrants; they do have smaller landholdings in Chitwan.

Finally, it appears that the factors that negatively impact the number of migrants the most are water and soil quality. We expected a positive impact for both these variables; poor land and input quality suggests a lower return to agriculture, which should encourage migration out of Chitwan, as it has done in the hilly regions of Nepal (Maharjan et al. 2012). Other push factors that have encouraged migration before include: higher unemployment, low literacy rates, corruption, political instability, lack of infrastructure, and poor access to credit, insurance markets and government services. The negative impact of poor quality agricultural inputs on the number of migrants could be one of two things: poor quality inputs reduce the ability of households to meet the costs of migration or it produces more uncertainty about leaving household members behind.

The remittance equation also has some interesting insights to offer. As expected, the coefficient on migration is positive and significant. The number of houses owned by the household and whether remittances financed previous land purchases encourages remittance receipts, providing strong support that remittances are received by more privileged households. Those who own more houses and land plots are in a better position to receive more remittances. In addition, transfers to households with more dependents are higher than those with fewer dependents, but smaller households receive more than larger households. It is plausible that the per capita remittance flow declines with household size, but it is not exactly clear why larger households receive less remittance. It may be that larger households are perceived to be more financially secure because more household labor is available to work on the family land. Larger households can also share risks and appear to be less vulnerable.

In terms of the ethnicity composition of the household, it is interesting to note that while lower caste families send fewer migrants than higher caste families, they send back larger monthly sums of remittances. This could suggest that higher caste migrants earn less abroad (and therefore, remit less), they are less likely to return (hence no need to remit as much), or they are migrating for longer periods of time. Higher caste migrants may be migrating with their whole immediate family, which has been shown to result in smaller amounts of monthly remittances in previous studies (Yang 2011). Higher caste families may not be sending remittances on a month to month basis, but in a large sum after a longer stay. Studies have found that migrants have an interest in how the remittance money is used, preferring that it is

invested in more substantial needs, like the construction of a new house or a repayment of loans (Yang 2011, Thieme and Wyss 2005). It should also be noted that remittance indicators may be subject to measurement error—some households may understate their true income, and higher caste households, or more privileged families, would have the greater incentive to do so (Grigorian and Melkonyan 2011). To evade taxes, for example.

Summary of Results—Third Stage

The results of the estimation of equation (3) using robust standard errors are presented in Table 3.3. The results support the risk hypothesis, but are not consistent with the credit hypothesis. The coefficient on remittance is insignificant, but it is negative (going against the credit hypothesis). Indirectly, this suggests that remittances do not help relax credit constraints in order to invest in agricultural production for families left behind. One explanation comes from the neoclassical model of labor supply, which suggests that remittance, a non-labor income, may decrease hours devoted to farming. Furthermore, households with more income (excluding remittance) are choosing not to invest in more agricultural technology. The coefficient is small and negligible, but it is negative. This either supports the trend that households in Chitwan are moving away from agriculture production with some of them becoming solely dependent on remittances (Theime and Wyss 2005, Maharjan et al. 2012) or it suggests the households took out large amounts of agricultural loans to finance the technologies. This makes sense when considering that households with agriculture as the main source of income adopt significantly more technologies than those that are not dependent on agriculture production. These households had to finance the technologies somehow.

Table 3.3. Technology Adoption, results of third stage regression

Technology	Coefficient		Robust Standard Error
Age	0.0121	*	0.01
Education	0.0281	*	0.02
Income	-0.0004	*	0.00
Main Source	0.2690	**	0.12
Cultivated	0.0202		0.03
Leased Out	-0.1081		0.32
Labor Scarcity	-0.4865		0.40
Infrastructure	0.1735	***	0.03
MHAT	0.1601	***	0.08
RHAT	-0.0003		0.00
C	1.5421		
Number of Observations	346		
Chi-Squared	80.47		

Note: ***, **, and * denote significance at 1%, 5%, and 10% respectively.
R-Square is not applicable in 3SLS

The coefficients on age, education and migration are positive and significant, suggesting that older and more educated household heads and households that have more absent family members due to migration adopt more agricultural technologies. Not only are the migrants insuring against crop failure, but they are also most likely sending back knowledge or information about labor saving technologies. The magnitude on migration is large. The number of agricultural infrastructures accessed also has a positive impact on the number of agricultural technologies adopted, all suggesting that if households are still interested in agricultural production, either for personal consumption or for commercial reasons, then migration is providing the impetus for some agricultural development. It is interesting to note at this point that cultivated land, leased out land and labor scarcity are not significant due to heteroskadasticity, and the need to use robust standard errors.

Conclusion

The paper uses data from Chitwan, Nepal to test the implications of migration and remittance flows on the behavior of receiving households. We found that remittance has no impact on the number of agricultural technologies adopted, but migration has a significant and positive one. Policy makers interested in increasing agricultural technology adoption need to target households receiving the most remittances. First, not all households in Nepal are able to afford the related expenses of migration, especially to international destinations. There are inherent disadvantages facing lower-caste and ethnic groups, and even if lower-caste households find the collateral to finance migration, it is not certain that their decision-making process and modes of production are conducive to agricultural development—for example, they may not have the education levels associated with higher adoption rates, as evidenced by the poverty alleviation programs that have achieved limited success in the western hills (Wagle 2010, Maharjan et al. 2012, Nepal FY).

Disturbingly, many of the technical interventions that have been disseminated to various Nepali households have not been adopted; during field study, it was observed that most farmers had *little to no knowledge* of some of the "modernizing" improvements that the National Agricultural Research Institute (NARI) and the Nepal Agricultural Research Council (NARC) suggested had been introduced in Nepal (see Manandhar et al. 2009). It should also be noted that not even the Nepali research assistants, with agricultural backgrounds, had knowledge of these technologies and improvements. Studies have found that agricultural techniques are better adopted when developed by first understanding what drives the farming community's behavior and decision-making processes, so there still remain significant work required to adapt agricultural technology for the Nepalese context. We should also consider that some of these technologies are not economically viable for small and marginal farmers, which is the most common landholding size in Nepal (Firdaus and Ahmad 2010, Wagle 2010).

With growing numbers of households choosing to allocate a significant portion of their labor force to migration, some may be dissuaded from participating in commodity production at all. There is evidence to suggest that landless households may only have a "precautionary demand" for agricultural land, which is purchased to simply *insure* against food insecurity with no intention of farming it (Lez-Vega et al 2004, Gartaula et al. 2012). Landowners, that choose not to participate in agriculture production, may not be selling it to those who do. Furthermore,

ruling elites in hierarchal societies already have better access to various kinds of improvements, and technical interventions would not gradually spread to the more disadvantaged society members unless marginalized groups are specifically targeted (FAO 2008, Nepal FY, Adefila 2012, Mendola 2007, Frost et al. 2007). Only when development initiatives succeed in securing greater participation by those most dependent on agriculture and those who have the available funds to invest in the agricultural infrastructure of this country, will it be possible to improve the security and sustainability of vulnerable households in Nepal.

CHAPTER 4
REMITTANCE AND CONSERVATION TECHNOLOGY ADOPTION

Introduction

Because rural households represent up to 70 percent of a developing country's total population, agricultural development has become the crux of many national and international development initiatives (Mendola 2007, Frost et al. 2007, Firdaus and Ahmad 2010, Ebojei et al. 2012, Kolawole et al. 2012, Mgbenka et al. 2012, Adefila 2012, Nepal FY). However, improving agricultural productivity does not just require a combination of factors comprising the right technology, effective extension, access to physical inputs, and adequate market support services, but it also requires effectively managing natural resources (Frost et al. 2007, Kolawole et al. 2012). Otherwise, an improperly applied poverty alleviation program aimed to increase agricultural productivity may exacerbate the problem of environmental degradation (Mgbenka et al. 2012). Improving agricultural productivity at the expense of land degradation may have grave implications for the long-run productive capacity, and thereby food security, of a country.

Sustainable development becomes inherently more complex when growing numbers of farming households are participating in internal (from rural to urban) or international migration. Migrant remittances may be used for consumption, with very little being used for sustainable investment or worse, may contribute to the degradation of an already vulnerable environment (Maphosa 2007, Lez-Vega et al. 2004, Massey et al. 2010). Increase in household income naturally impacts the environment. For example, increased remittance has been linked to clearing new land in El Salvador, which has led to severe erosion and environmental risks (Lez-Vega et al. 2004). Nepal is an ideal country to study all the facets of migration, remittance, and their impact on natural resource conservation. The Government of Nepal (GON) started encouraging migration in the aims to reduce poverty, and remittance already amounts to 25.83% of GDP, and it is expected to grow (Nepal Bastra Bank, 2014, Agrawal and Gupta 2005, Thieme and Wyss 2005, Yang 2011).

Nepal is small, landlocked, and all Nepalese directly or indirectly depend on natural resources. However, a quarter of Nepal's population still live on less than US$1 a day, and it has one of the largest inequality indexes in Asia (Wagle 2010). The poor—by virtue of having less secure access to income, credit and time constraints so that any new endeavor has to compete with established livelihood activities—are unable and often unwilling to invest in natural resource management (Frost et al. 2007, Ahmed and Rayhan 2012, Mgbenka et al. 2012). For example, if a household faces labor shortage due to out-migration, it may be inhibited from using conservation methods that are more labor intensive. Out-migration may also induce moral hazards, "Often overlooked are the loss of productive labor for the home country as well as the potential disincentives to work, study, and stay in the home country for the family members left behind" (Grigorian and Melkonyan 2011). On the other hand, a decrease in hours *devoted to farming* may help conservation by allowing the land to remain fallow or for

households to plant trees instead of cultivating crops (conservation methods requiring low-maintenance).[7]

Only when development initiatives succeed in securing greater participation in natural resource conservation, will it be possible to meet the objectives of distributing the benefits of improved agricultural productivity to the most vulnerable. If carried out appropriately, the large remittance receipts have the *potential* to fund resource-conserving technologies (Firdaus and Ahmad 2010). However, if households use remittance income to adopt agricultural practices that degrade the environment, the developmental impact of migration and remittance may not be sustainable (FAO 2008). The sub-optimal agricultural investments may exacerbate the problem of environmental degradation. For example, moving from oxen pulled wooden/iron plough to a tractor is a good agriculture technology but it increases soil sediment loss resulting in decreased soil productivity and increased water pollution. Degradation of natural resources is widely seen as the root cause for stagnating agricultural productivity, which would negatively impact food security (FAO 2008).

This micro-level study aims to answer a significant question regarding the impact of an important institution, migration, on the sustainable agricultural development of a country with limited agricultural resources—providing for an overly optimistic view fails to provide an appropriate framework for regulation and policy formation for more vulnerable economies. The rest of the paper proceeds as follows. The data and methodology sections discuss variables, model and the estimation procedure used—because the issue of endogeneity in estimating the impact of migration and remittance on various household decisions was frequently mentioned in the literature, we used an instrumental variable approach to account for the selectivity bias. While a researcher lived through an agricultural season in Nepal, a wide range of social and economic features of the society, such as resource use and property rights were clarified—providing the social, institutional, and environmental framework for the study. The results section discusses the impact of migration and remittance on the number of soil and water conservation methods adopted and we conclude by summarizing the implications and making policy suggestions.

Data

With funding from USAID and the cooperation of the International Maize and Wheat Improvement Center (CYMMYT), a researcher lived in Nepal during (Jan-March) 2013 to collect cross-sectional data from representative rural households. Chitwan, a district in the south-central region of the country, was selected based on the sample of the population participating in migration and the level of agriculture production—it is considered one of the most agricultural developed districts in Nepal. A questionnaire was used over a two-month period, and several informal interviews were conducted after to clarify resource use and property rights. The questionnaire was adopted from two previous studies: one conducted by the University of Guadalajara and Princeton University and the other conducted by the University of Michigan in Nepal. The survey was designed to collect both qualitative and quantitative data,

[7] Leaving land fallow is very unlikely in our study aread, as it is facing severe a decline in per capita availability of agricultural land, resulting in alarmingly high land prices (Massey et al. 2010).

and it was tested during a focus group and modified for appropriate content. It captured information about individuals who were present and those individuals who were not present due to migration.

The stratified random sample included small, medium, and large sized landholders selected from seven Village Development Committees (VDC) in eastern Chitwan: Bachhauli, Birendranagar, Chainpur, Jutpani, Kathar, Padampur, and Piple. While 396 households were surveyed, many did not make decisions about agricultural production and soil and water conservation methods (they leased out all their land) or felt uncomfortable revealing information about caste, a demographic variable that researchers have suggested in some measure explains the choice of livelihood strategy in Nepal (Wagle 2010; Massey et al. 2010, Williams 2009). Restricting this sample to those who made agricultural decisions in 2012 and answered information regarding caste yields a sample of 338. The data set is useful in that it not only contains family profile: education, health, nutrition, income, assets, and expenditures, but it also includes the household's agricultural activities, such as input use and agricultural output, and off-farm business activities. The data set also contains a number of household and community level variables—consistent with other cross-sectional data used in the literature (Quinn 2009; Grigorian and Melkonyan 2011).

The dependent variable of interest is the number of water and soil conservation methods that household *i* utilized (I_i) in 2012. It is a discreet variable ranging from 0 to 14, with the average number of conservation methods used by households in Chitwan being 5. A discrete variable is consistent with previous research that considers the intensity of adoption; some technologies and/or methods are presented in a package with several components, which can be adopted together or independently (Feder et al. 1985). Some of the sustainable agricultural practices included in the questionnaire were taken from a report published by the National Agricultural Research Institute (NARI) and the Nepal Agricultural Research Council (NARC) (see Manandhar et al. 2009), suggesting they had been introduced in Nepal. The soil and water conservation methods included in the survey were crop rotation, minimum tillage, rainwater harvesting system, wastewater reuse, planting trees and shrubs around the farmland, and use of straw to cover the plot after land preparation, among others.

There have been several studies suggesting that selectivity issues are present when modeling migration and household investments, including conservation decisions (Curran 2002; Rozelle et al. 1999; Quinn 2009; Grigorian and Melkonyan 2011; Basank and Chezum 2009; Adams and Page 2005; Carletto et al. 2011). We use an instrumental variable approach to account for the selectivity bias, and while the test for endogeneity is discussed in the results section, we present two variables which are both explanatory and dependent variables in the analysis: the number of individuals (over the age of 12) from household *i* who left the home in the previous year[8] (M_i) and the average amount of monthly remittances in US$ received by the household in the previous year (R_i). We did not use a dichotomous variable for whether remittance was used to finance soil and water conservation (Quinn 2009) due to fungibility reasons—remittances can be used for various purposes.

[8] The age of 12 was selected to capture individuals who would have participated in household production had they lived at home.

The explanatory variables used in the paper consists of vectors X_i, Z_i, and W_i, with variables in X_i being the socio-economic characteristics of the household, including age of household head, years of education of household head, income, total size of cultivated farm plots operated by the household, the amount of owned land that was leased out, and the number of agricultural infrastructure accessed last year. The vector X_i also includes dichotomous variables indicating whether agriculture is the main source of income, if the land is unproductive, the water quality is bad, and if the household experienced labor scarcity in the previous year. The vectors Z_i, and W_i are instrument variables that are used to identify both M_i and R_i, but are not correlated with the number of soil and water conservation methods adopted I_i. The instrument variables explain both M_i and R_i without explaining I_i. The variables in Z_i are the number of migration experiences and the number of rooms (housing size) and the variables in W_i are the number of houses owned by household *i* and whether or not remittances was used to finance land. The descriptive statistics of the variables used in the study are in Table 4.1.

A review of conservation agriculture studies revealed that there are few if any influences on adoption that apply universally (specific factors are highly contextual and vary by location), but there are expected signs for the variables in X_i. The average age of a household head in Chitwan is 52.7, which may be considered elderly in developing countries; for example, a study of horticultural production in Nigeria suggested that 40 years of age was considered an older farmer (Okafor and Fabiyi 2011). However, we expect age to positively impact the number of conservation methods used; age may indicate the level of farming experience, knowledge of natural resources, and level of participation—there is evidence that young people in Nepal are not really interested in working in agriculture (Adefila 2012; Gartaula et al. 2012; Thieme and Wyss 2005).

We expect income, whether agriculture is the main source of income, hectares of land cultivated, the number of agricultural infrastructure (such as extension and irrigation) accessed, bad water quality, and low levels of land productivity to have a positive impact on the number of soil and water conservation methods adopted. Wealthier and larger landowners may have more resources and the incentives to pay the costs associated with conservation (Firdaus and Ahmad 2010; Ebojei et al. 2012; Feder et al. 1985). The rural poor have less secure access to income, credit and time constraints—they are often unable and unwilling to invest in natural resource management (Frost et al. 2007, Ahmed and Rayhan 2012, Mgbenka et al. 2012)**.** Some conservation methods also require complimentary inputs that are acquired through extension, market, and other agricultural infrastructures (Firdaus and Ahmad 2010, Mgbenka et al. 2012, Agrawal and Gupta 2005). Moreover, poor agricultural inputs have been among the main driving forces for quick adoption of No-tillage agriculture in other regions of the world (FAO 2012).

Some studies found that education has a positive effect (Mgbenka et al. 2012; Firdaus and Ahmad 2010; Bansak and Chezum 2009; Agrawal and Gupta 2005), but it is possible that increased education levels may have a negative impact (Adeola et al. 2011). It may be easier for more educated individuals to use modernizing improvements or it may lead to off-farm income. We expect the amount of owned land leased out to have a negative effect; as more agricultural lands are given over to the land rental market in Nepal, which is sharecropping, there will be less incentives to conserve (Ahmed and Rayhan 2012, Maharjan et al. 2012, Gartaula et al.

2012). Labor intensive conservation methods may also be affected by the availability of labor. Most of the landowners in Chitwan produce rice, which still remains a labor intensive activity and it should be expected that water and soil conservation methods would be as well. Labor scarcity has negatively impacted adoption in other studies (Feder et al. 1985, Acemoglu 2010).

Table 4.1. Conservation Technology, descriptive Statistics by household, Chitwan 2013

Variable	Description	Mean	Standard Deviation
Dependent Variables			
Migrants	# of household members who lived away	1.38	1.66
Remittances	average monthly remittances received in US$	190.59	333.03
Conservation	# of agricultural conservation methods adopted	5.01	2.55
Exogenous Variables			
Income	average monthly income minus remittances in US$	280.43	637.58
Main Source	agriculture is main source of income (0/1)	0.59	0.49
Age	age of household head	52.86	13.89
Caste	High Caste (base) Low Caste (2) Mongolian (3) Indigenous (4)	2.10	1.22
Education	years of education of household head	5.47	5.08
Male Education	years of education of household males	25.02	13.72
Female Education	years of education of household females	20.04	15.25
Household Size	# of household members	6.46	2.78
Dependents	# of household members under 12 and over 65	1.47	1.39
Owned Land	total # of hectares owned by household	1.13	4.16
Cultivated Land	total # of hectares cultivated by household	0.97	2.65
Leased Out	total # of hectares owned by household and leased out	0.13	1.15
Infrastructure	# of agricultural infrastructure used	7.51	2.64
Production Quality	land productivity is bad (0/1)	0.02	0.14
Water Quality	water quality is bad (0/1)	0.24	0.42
Soil Quality	soil quality is bad (0/1)	0.05	0.21
Labor Scarcity	household experienced labor scarcity (0/1)	0.06	0.23
Instrument Variables			
Experiences	# of migration experiences in household	0.98	1.06
Rooms	# of rooms	4.65	3.25
Houses	# number of houses owned by household	1.14	0.39
Financed	remittance financed land purchase (0/1)	0.17	0.38

Methodology

A common problem in estimating any impact of migration in household behavior is that unobserved household characteristics may be correlated with both the outcome of interest and the likelihood of migration. Similarly, remittances should not be viewed as exogenous; households with more migrants should receive more remittances. Migrant families are also not randomly selected among a particular community; selection issues can pose identification problems. While one equation assumes all variables on the right hand side are exogenous, and a two-stage least squares (2SLS) technique addresses the problem, we are unable to study both migration and remittance together. We applied a three-stage least squares (3SLS) technique to estimate migration, remittances, and adoption of conservation technology simultaneously. The conceptual model is adopted from Rozelle (et al. 1999), Quinn (2009), Grigorian and Melkonyan (2011), and Bansak and Chezum (2009).

First, consider that the household chooses the number of migrants to send out (internal and international):

$$M_i = \beta_o + X_i\beta_1 + Z_i\beta_2 + \epsilon \qquad (1)$$

where X_i is the vector of household characteristics, which includes household demographics, human capital and physical capital variables, and Z_i is the vector of instruments used to properly identify M, and ϵ are the error terms. The individual household is denoted by i=1, 2 ,3, …, n.

Given the number of migrants, they will make the decision on the amount to remit, R. It is determined as:

$$R_i = \alpha_o + X_i\alpha_1 + \widehat{M}_i\alpha_2 + W_i\alpha_3 + \epsilon \qquad (2)$$

where X_i is the vector of household characteristics, $\widehat{M}_i$ is the predicted value from the first equation, and W_i is the vector of instruments to properly identify R.

Finally, the household will choose the number of soil and water conservation methods to adopt:

$$I_i = \delta_o + X_i\delta_1 + \hat{R}_i\delta_2 + \widehat{M}_i\delta_3 + \mu' \qquad (3)$$

where the predicted values $\widehat{M}_i$ and $\hat{R}_i$ from the first two equations are included in the investment equation. So, the number of individuals from household *i* who lived away in the previous year M_i and average monthly remittances received R_i, are two variables that are both explanatory variables and dependent variables. The three-stage approach equations:

$$M_i = \beta_o + X_i\beta_1 + Z_i\beta_2 + \epsilon \qquad (1)$$

$$R_i = \alpha_o + X_i\alpha_1 + \widehat{M}_i\alpha_2 + W_i\alpha_3 + \epsilon \qquad (2)$$

$$I_i = \delta_o + X_i\delta_1 + \hat{R}_i\delta_2 + \widehat{M}_i\delta_3 + \mu' \qquad (3)$$

Results

Testing for Endogeneity and Instrument Validity

The results from the Hausman-Wu test for endogeneity support the choice to use an instrumental variable approach instead of OLS. The null hypothesis of exogeneity of migration and remittances in the conservation regression can be rejected at the 90% confidence level; the t-statistic on the individual residual variables are -1.69 and 0.23, respectively. The t-statistic on the remittance residuals is small, but remittances should not be viewed as exogenous—households with more migrants should receive more remittances. Besides, there is more than one variable being tested for endogeneity, turning the endogenity test into an F-test of joint significance (Hill 421). Other papers have demonstrated the difference in the probit and the instrumental variable approach (see Quinn 2009), and many others have concluded that an unobservable factor influencing the propensity to migrate and remit is correlated with the regression error terms, if modeling household investment decisions like conservation, thereby making the probit or OLS estimators biased.

We formally test the instruments for validity. A valid instrument must significantly impact $\widehat{M}_i$ and $\widehat{R}_i$ and be uncorrelated with the conservation regression error term. The tests of joint significance of the instruments in the migration and remittance equations yield an F-test statistic of 21.21 and 10.06, respectively. To reject the hypothesis that the instruments are weak or that the true value of the instruments are zero, the rule of thumb is that the F-test statistic should be greater than 10 (Hill 414). The instruments pass the first condition. We use the Sargan-Hansen test to determine whether the instruments are uncorrelated with the error term, and that the instruments are correctly excluded from the estimated equation. The null hypothesis is that the instruments are valid, and we fail to reject the null for the variable vectors Z_i, and W_i with a chi-square value of 0.033 and 0.014, resulting in p-values of 0.86 and 0.91, respectively.

Summary of Results—First and Second Stage

The estimation results with robust standard errors for equations (1) and (2) are presented in Table 4.2. As predicted, the number of migration experiences encourages migration. The coefficient on experience is positive and highly significant. We find that it is the factor that encourages migration the most. This is consistent with the literature—Nepal has a culture of migration, Thieme and Wyss (2005) suggested it has become "institutionalized". The association with a migrant greatly increases the odds of out-migration due to increased information flow, assistance with employment opportunities and help with accommodations in other studies (Thieme and Wyss 2005, Wagle 2010, Carletto et al. 2011). We also found that households with more dependents (children and elderly) decrease the number of household members migrating, while household size positively impact migration.

Surprisingly, families with larger properties are not sending out more migrants. Land ownership in Nepal is associated with social status and wealth, and concentration of land holdings to act as collateral, would mean these households have better access to institutional credit, which we expected would put them in a better position to send out migrants. The

negative impact of owned land may indicate that larger landowners have access to sufficient income-generating sources in Chitwan, and do not need to send more migrants for economic opportunities outside the district. Land ownership can be a proxy for wealth, which means households with a lot of wealth do not have the incentive to leave (Griogorian et al. 2011). There may be other reasons as well. Consider that larger land owners may need more household labor to cultivate land, especially if the culture of migration creates labor scarcity during peak agricultural seasons. Or the negative sign reflects the hand full of landowners in the sample who owned very large plots. For example, we found one household owned over 60 hectares of land (average is 1.10 hectares), but was removed from the sample as an outlier. The coefficient on owned land is not very large and is only significant at the 90% confidence level.

Table 4.2. Conservation Technology, results of the first and second stage regressions

Migration				**Remittances**		
	Coefficient		Robust Standard Error	Coefficient		Robust Standard Error
Male Education	0.00		0.01	3.49		2.28
Female Education	-0.01		0.01	3.76	*	2.02
Income	0.00		0.00	-0.04		0.05
Household Size	0.41	***	0.05	-91.94	***	25.90
Dependents	-0.17	***	0.06	40.40	***	15.81
Owned Land	-0.05	***	0.02	7.99		7.90
Caste						
Low	-0.39	*	0.23	120.86	***	44.73
Mongolian	-0.08		0.17	81.35	**	41.48
Tharu (Indigenous)	-0.42	**	0.18	82.37		55.54
Water Quality	-0.37	***	0.16	75.68		47.27
Soil Quality	-0.57	*	0.34			
Migration Experience	0.42	***	0.09			
# of Rooms	0.00		0.02			
MHAT				218.56	***	46.30
Houses				126.24	**	60.72
Financed				93.05	*	52.67
Number of Observations	338			338		
Chi-Squared	374.50			134.50		

Note: ***, **, and * denote significance at 1%, 5%, and 10% respectively.
R-Square is not applicable in 3SLS

Coupled with our findings of the ethnic composition of households sending more migrants, there could be a more prosaic reason why landholding size in Chitwan does not act as

collateral for migration. Other studies found that not all households in Nepal have sufficient income-generating sources; differential access to land is present, with the majority owning small or marginal sized plots (Wagle 2010). We also found that some households do not own land, but rent the land they cultivate. However, we propose that while marginalized and lower caste households have generally faired with smaller landholdings in other parts of Nepal (resulting in limited mobility), there are cultural norms that are driving the decision-making practices of the Tharu or indigenous people that should be accounted for in the migration analysis. They have larger landholdings, but seem to be more attached to their "ancient" landholdings than the people who migrated to Chitwan in the past fifty years. Our study finds that they send fewer migrants than higher caste households. The indigenous population would not migrate even if they had the collateral to do so. However, this excludes the lower caste households that are sending out fewer migrants; they do have smaller landholdings in Chitwan.

Finally, it appears that the factors that negatively impact the number of migrants the most, after the ethnic composition of the household, are water and soil quality. We expected a positive impact for both these variables; poor land and input quality suggests a lower return to agriculture, which should encourage migration out of Chitwan, as it has done in the hilly regions of Nepal (Maharjan et al. 2012). Massey (et al. 2010) also found that degradation and environmental hazards would push migrants out of Chitwan. Other push factors that have encourage migration in the literature include: higher unemployment, low literacy rates, corruption, political instability, lack of infrastructure, and poor access to credit, insurance markets and government services. The negative impact of poor quality agricultural inputs on the number of migrants could be one of two things: poor quality inputs reduce the ability of households to meet the costs of migration or it produces more uncertainty about leaving household members behind.

The remittance equation also provides some revealing insights. As expected, the coefficient on migration is positive and highly significant. The number of houses owned by the household and whether remittances financed previous land purchases encourages remittance, providing strong support that remittances are received by more privileged families. Those who own more houses and land plots are in a better position to receive more remittances. In addition, transfers to households with more educated females and dependents are higher than those with lower female education levels and fewer dependents. Thieme and Wyss (2005) and Basank and Chezum (2009) found that migrant remittances are being siphoned toward children's education. However, smaller households receive more remittances than larger households. It may be that larger households are perceived to be more financially secure because more household labor is available to work on the family land. Larger households may also appear to be less vulnerable because they can share risks. In terms of the ethnicity composition of the household, it is interesting to note that while lower caste families send fewer migrants than higher caste families, they send back larger monthly sums of remittances. This could suggest that higher caste migrants earn less abroad (and therefore, remit less), they are less likely to return (hence no need to remit as much), or they are migrating for longer periods of time. Higher caste migrants may be migrating with their immediate family, and previous studies have shown that they are more likely to send smaller remittances (Yang 2011). We should also consider that higher caste families may not be sending remittances on a month to month basis, but in a large sum after a longer stay. Studies have found that migrants have an

interest in how the remittance money is used, preferring that it is invested in more substantial needs, like the construction of a new house (Yang 2011, Thieme and Wyss 2005). It should also be noted that remittance indicators may be subject to measurement error—some households may understate their true income, and higher caste households would have the greater incentive to do so. To evade taxes, for example (Grigorian and Melkonyan 2011).

Summary of Results—Third Stage

The estimation results for equation (3), using robust standard errors, are presented in Table 4.3. The results do not support the risk hypothesis, but are consistent with the credit hypothesis. The coefficient on remittance is insignificant, but it is positive (supporting the credit hypothesis). Furthermore, households with more income (excluding remittance) are choosing not to invest in more water and soil conservation methods. The coefficient is small and negligible, but it is negative. It appears that very little capital (both income and remittance) is being syphoned toward sustainable agricultural development. This either supports the trend that households in Chitwan are moving away from agriculture production, haphazardly adopting technologies without considering natural resource conservation (took out agricultural loans to do so), or conservation methods are more labor intensive than capital intensive in the study area.

Table 4.3. Conservation Technology, results of the third stage regression

Technology

	Coefficient	Robust Standard Error
Age	0.0175	0.01
Education	-0.0080	0.03
Income	-0.0006 *	0.00
Main Source	0.6268 **	0.31
Cultivated	0.0095	0.10
Leased Out	-0.1272	0.40
Labor Scarcity	0.7468	0.64
Water Quality	0.6892 *	0.41
Productive Quality	-2.2243 **	1.06
Infrastructure	0.3184 ***	0.08
MHAT	-0.3114 *	0.18
RHAT	0.0003	0.00
C	1.7593 **	0.87
Number of Observations	338	
Chi-Squared	90.80	

Note: ***, **, and * denote significance at 1%, 5%, and 10% respectively.
R-Square is not applicable in 3SLS

The latter makes sense when considering the following: households with agriculture as the main source of income adopt significantly more conservation technologies than those that are not depended on agriculture production, but if they experienced the loss of family labor through migration, they were disinclined to practice sustainable agriculture. The migrants are not insuring against crop failure or loss of productivity; the magnitude on migration is large. The water quality that negatively impacted migration in equation (1) encourages soil and water conservation in the third regression (by keeping the potential migrant at home). The number of agricultural infrastructures accessed also has a positive impact on the number of conservation methods adopted, all suggesting that if households are still interested in agricultural production, either for personal consumption or for commercial reasons, and not migrating in large numbers, are more likely to conserve natural resources.

The factor that discourages conservation the most is unproductive land. The coefficient on land productivity is negative and significant. Ironically, low productivity in Nepal, as in other countries, results from inappropriate land use and poor land management practices—affecting the time spent on agriculture, the quality and quantity of water available, and the soil nutrients that are available for production (Ahmed and Rayhan 2012, Alam et al. 2008, Firdaus and Ahmad 2010, Frost et al. 2007). Degradation of natural resources is also seen as a root cause for stagnating agricultural productivity—Nepal is small, landlocked, and all Nepali households directly or indirectly depend on natural resources (Frost et al. 2007, Kolawole et al. 2012). Their conventional farming practices, like shorter periods of fallow land (preventing the soil from naturally regenerating itself) are destroying the soil's supportive ability and resulting in low agricultural outputs. The households experiencing low agricultural productivity should be adopting the most conservation methods to increase crop yields while simultaneously supporting the productive capacity of its soil and water resources, but we find the opposite reality in Chitwan.

Conclusion

The paper uses data from Chitwan, Nepal to test the implications of migration and remittance flows on the behavior of receiving households. Because the issue of endogeneity in estimating the impact of migration and remittance on various household decisions was frequently mentioned in the literature (Rozelle et al. 1999; Quinn 2009; Grigorian and Melkonyan 2011; Basank and Chezum 2009; Adams and Page 2005; Carletto et al. 2011), we used an instrumental variable approach to account for the selectivity bias. One equation assumes all variables on the right hand side are exogenous, and while a two-stage least squares (2SLS) technique is appropriate for addressing the problem of endogeneity, we were unable to study migration and remittance together. We therefore applied a three-stage least squares (3SLS) technique to estimate migration and remittances simultaneously.

We found that remittance has no impact on the number of soil and water conservation methods adopted, but migration has a significant and negative one. The more migrants in the household do not necessarily translate into more remittances being siphoned away toward conservation. Policy makers interested in increasing the number of conservation methods adopted need to target households sending out the most migrants. With growing numbers of households in Chitwan allocating a significant portion of their labor force to migration, labor

scarcity during peak agricultural seasons may become hazardous for sustainable agricultural development. Fortunately, there exists a cultivation practice that would tackle head-on the poverty trap of poor farm assets and is not labor or capital intensive, so migrant households could chose to adopt them at a greater rate due to the minimal labor requirements (FAO 2008, FAO 2012). Conservation Agriculture (CA) is a sustainable and an environmentally friendly management system that includes practices such as minimum tillage, improved crop varieties, intercropping, and the use of cover crops (Laia et al. 2012).

CA has the potential to mitigate the depletion of soil nutrients, increase crop yields, and conserve soil and water (FAO 2008, FAO 2012). It also makes it possible to insert a high value vegetable crop in the agricultural system by decreasing turnaround times—diversification of agriculture in favor of more competitive and high-value commodities may help overcome the deteriorating condition of small and marginal farmers; the systems maintain their staple base while generating additional income (Nepal FY). CA has been introduced in Chitwan, but it is not practiced *permanently* because the farmers still plough the land or use intensive tillage practices for rice, in a rice and wheat-based agricultural system; rice farming is part of the culture and many such farming systems are subject to cultural and religious habits, but rain fed small holder agriculture in this country, with significant loss-labor effects from out-migration, may benefit from the widespread use of this soil and water conservation method (FAO 2008, FAO 2012, Maharjan et al. 2012).

Optimistically, Nepal's Feed the Future program is utilizing CA as part of their country investment plan. While the lack of proper herbicides in Nepal may hinder the widespread adoption of CA, poverty and mindset—factors accelerating environmental degradation, will require more than available inputs, but training and education among more vulnerable farmers—in hierarchal societies, ruling elites have better access to various kinds of improvements, and technical interventions would not gradually spread to the more disadvantaged society members unless marginalized groups are specifically targeted (FAO 2008, Nepal FY, Adefila 2012, Mendola 2007, Frost et al. 2007). Because not all households are able to afford the related expenses of migration—there are inherent disadvantages facing lower-caste and ethnic groups—CA must be promoted among higher caste families as well (households with the most migrants).

As our findings are related to studies from other parts of the world, we will gain a better understanding of the impact of migration and remittance on the sustainable use of natural resources, especially of the rural poor who are vulnerable to environmental hazards. Prieur (2009) said that, "economic poverty results from ecological poverty." The determinants of adopting resource-conserving technologies can facilitate better policy design, and with adequate policies to encourage CA, agricultural development could converge with natural resource conservation, allowing migration and remittance to be a catalyst for sustainable agricultural development in rural Nepal—improving many household's resilience to vulnerabilities like food insecurity.

CHAPTER 5
REMMITANCE AND IMPACTS ON SCHOOLING OF CHILDREN IN NEPAL

Introduction

Many people in Nepal lack the appropriate education and social capital to access good local jobs. Because of underemployment, unemployment and an increased wave favoring foreign employment, a growing number of households are choosing to participate in international or domestic (from rural to urban) migration (Thieme and Wyss 2005, Wagle 2010, Massey et al. 2010, Williams 2009, Yang 2011). Not all households are able to afford the related expenses, especially to international destinations—suggesting that households with access to migration, as a livelihood strategy, are in a better position to receive remittances, the portion of the migrant's earnings sent back to the family remaining behind (Wagle 2010).

Remittance-recipients usually do not have an obligation to repay, and "at the household-level, these remittances are likely to have important income effects, as well as possibly relax binding liquidity, credit, or insurance constraints" (Carletto et al. 2011). The extra income can be used for several purposes: it can facilitate investment or afford rural households the means of securing daily food requirements and escaping poverty (Mendola 2007, Yang 2011, Frost et al. 2007, Carletto et al. 2011, Thieme and Wyss 2005). Remittances already amount to 25.83% of Nepal's GDP, so if migration is to foster sustainable development, this source of income has to eventually be channeled toward productive investments (Nepal Bastra Bank 2014, Thieme and Wyss 2005, Yang 2011). One of these productive investment outlets may be children's education, contributing to the human capital stock in this country.

If households participating in migration invest in children's education because of relaxing budget constraints and/or reducing child labor through the increase in income (indirect effect), then remittances may have a positive impact on human capital formation, improving the households' opportunities for off-farm income (Williams 2009, Bansak and Chezum 2009, Acosta 2011, Amuedo-Dorantes et al. 2010). The problem arises when there is uncertainty around the impact of labor loss on the children left behind (Thieme and Wyss 2005, Bansak and Chezum 2009, Acosta 2011). Out-migration may require children to take up extra household duties to compensate for the loss of productive labor or create disincentives to study in case of migrant children with less parental oversight (Bansak and Chezum 2009, Acosta 2011, Amuedo-Dorantes et al. 2010, Grigorian and Melkonyan 2011).

To further complicate the migration and education analysis in Nepal, there are social and institutional features of the Nepalese context that should also be considered in this poverty alleviation scheme—unregulated migration may have deleterious consequences on the *long-term* inequality rate. While research confirms that households are using a large portion of remittances to educate their children (Bansak and Chezum 2009, Thieme and Wyss 2005), it remains unclear whether the increase in average education levels represent the reality for every ethnic group[9]; as Wagle (2010) has suggested in his study of poverty reduction in Nepal,

[9] There are 100 different castes and ethnic groups in Nepal, and researchers have often subdivided them into five to seven categories in order to simplify analysis (Williams 2009, Wagle 2010, Massey et al. 2010).

"group averages do not fully capture everyone's economic experiences." So an issue that has been notably overlooked is the differential consequences that migration of different population groups may generate.

The Hindu caste system in this country already reserves the well-paid and respectable jobs for higher caste people, and while many inequality-reducing initiatives are underway discrimination is still deep rooted in society (Thieme and Wyss 2005, Wagle 2010). Even when lower-caste households find the collateral to finance migration or secure a non-agricultural job, it is not certain that they will invest in their children's education (Wagle 2010, Maharjan et al. 2012, Nepal FY). The importance of human capital investments for economic development cannot be overstated. Few would consider current education levels in Nepal sufficient to sustain economic growth.

Formidably, migration may lead to a growing dependence on remittance income, with most of it being used for consumption and very little being used for productive investments; or worse, migrant remittances could lead to further inequality in educational outcomes, possibly preserving the caste-based discrimination present in certain parts of the country (Laia et al. 2012, Thieme and Wyss 2005, Massey et al. 2010, Wagle 2010). The role of remittances, especially from undocumented migrants,[10] remains a fruitful field of research, and to date, there has been little published on its impact on human capital formation in the Chitwan Valley, one of the most agriculturally developed regions of Nepal.

The first school in the area was set up in 1954, and since the 1950s there has been a steady proliferation in the number of schools established in Chitwan, from only ten in 1960, to over 100 in the early 1990s. Public schooling was formally instituted nationwide in 1951, and is comprised of primary schools, educating children up to 5th grade, lower secondary schools comprising 6th and 7th grade, upper secondary schools, completing up to 10th grade, and the option of attending two additional years of higher secondary school, which includes 11th and 12th grades. By the mid-1990s, 100% of children in the Chitwan Valley, ages five and six, had attended school for at least one day and more than half attended at least three years of school (Williams 2009).

Because the magnitude and intensity of factors leading to household investments have varied from one place to another based on the agro-ecological, socio-economic and institutional settings, this micro-level study aims to contribute to the body of literature focusing on resource limited countries in Asia. Our study helps enhance the development community's understanding of how Nepali households' decision-making process and their use of remittance income impact children's education. Educational attainment promotes positive social change in individuals and community, so providing for an overly optimistic view of out-migration fails to provide an appropriate framework for poverty alleviation programs.

The rest of the paper proceeds as follows. Context and data show the main migration trends in the cross-sectional data we collected in Chitwan in 2013, the sample and variables used in this study. The methodology section discusses the model and the estimation

[10] Nepalese have a long history of seeking employment in India, which is now facilitated by the Treaty of Peace and Friendship of 1950 (open border), and it remains the destination of choice for most of migrant households in Nepal (Thieme and Wyss 2005).

procedure—because the endogeneity issue was frequently mentioned in the literature when estimating the impact of migration and remittance on various household decisions, we used an instrumental variable approach to account for the problem. The results section discusses the impact of migration and remittance on the education expenditure of school age household members and we conclude by summarizing the implications and making policy suggestions.

Context and Data

This study is part of a collaborative effort to research and promote sustainable food systems in Nepal. With the assistance of the International Maize and Wheat Improvement Center (CYMMYT) and funding from USAID, we collected cross-sectional data of representative households during (Jan-March) 2013. The eastern side of the Chitwan Valley was selected for agriculture dominance and the sample of the population participating in migration. The Chitwan Valley is an agriculturally fertile area in south-central Nepal, which was originally opened up for settlement through extensive deforestation efforts back in the 1950's—the Government of Nepal's (GON) population distribution policy to overcome food shortages in the hilly areas. It is one of the more agriculturally productive districts in Nepal, and unlike the hills, which can experience gradients of over 30 degrees, the soil is rich and flat, conducive to growing specialty crops like mustard and traditional crops like rice, wheat and maize (Massey et al. 2010, Maharjan et al. 2012, Williams 2009).

The questionnaire was adopted from two previous studies: one conducted by the University of Guadalajara and Princeton University in Mexico and the other conducted by the University of Michigan in Nepal. The survey collected both qualitative and quantitative data, and it was initially tested during a focus group and modified for appropriate content. The survey captures the detailed activity, income and expenditure information of 396 households that were randomly selected and stratified by small, medium, and large landholding size. The households were located in seven Village Development Committees (VDC) in eastern Chitwan: Bachhauli, Birendranagar, Chainpur, Jutpani, Kathar, Padampur, and Piple. The data set is useful in that it not only contains family profile: education, health, nutrition, income, assets, and expenditures, but it also includes the household's agricultural and off-farm business activities. It captures information about individuals who are present and those individuals who are not present because of migration.

Our interest is to understand the impact of migration on schooling differences across ethnic groups. Table 5.1 shows mean characteristics of households in the data, grouped by caste. The rest of this section shows the main trends of migration behavior for eastern Chitwan. Are there observable differences in migration patterns, controlling for the ethnic composition of the household? Table 5.2 shows the Poisson regression results (with robust standard errors) for household's decision about migration. The dependent variable is the number of individuals (over the age of 12) from household *i* who left the home in the previous year.[11]

The number of migration experiences are associated with more migrants, which is partially explained by the culture of migration Thieme and Wyss (2005) found in another

[11] The age of 12 was selected to capture individuals who would have participated in household production had they lived at home.

district. The association with a migrant greatly increases the odds of out-migration due to increased information flow, assistance with employment opportunities and help with accommodations in other studies (Thieme and Wyss 2005, Wagle 2010, Carletto et al. 2011). Consistent with the literature, households with more dependents (children and elderly) are negatively associated with the number of household members migrating, while household size is positively associated (Grigorian and Melkonyan 2011).

Table 5.1. Household mean by caste, eastern Chitwan, 2013

Caste	High Caste	Low Caste		Mong.		Tharu		Not Reported	
Total Migrants	1.48	1.35		1.35		1.03	***	1.76	
Monthly Remittances in US$	192.79	214.50		222.59		132.45	*	214.00	
Monthly Income in US$	300.10	231.65	*	198.52	***	369.74		200.13	***
Age of Household Head	54.49	54.08		50.32	***	49.05	***	56.69	
Male Education	27.24	21.85	**	23.13	***	22.65	***	26.67	
Female Education	22.28	18.66	*	19.63	*	16.02	***	20.80	
Household Size	6.30	6.85		6.31		6.62		7.15	
Dependents	1.45	1.73		1.37		1.34		1.82	
Owned Land	0.89	0.99		1.44		1.40		2.81	
Family Agricultural Workers	3.35	3.85		3.18		4.85	***	5.00	**
Water Quality	0.24	0.28		0.29		0.17	**	0.18	
Soil Quality	0.04	0.03		0.06		0.04		0.09	
Experiences	1.03	1.20		0.97		0.58	***	1.36	
Rooms	5.17	3.73	***	4.34	***	4.12	***	4.73	
Houses	1.16	1.08	**	1.07	***	1.16		1.21	
Remittance Financed Land	0.15	0.13		0.19		0.22	*	0.24	

Note: ***, **, and * denote significantly different from High Caste at 1%, 5%, and 10% respectively.

It appears that the factors that negatively impact the number of migrants the most, after the ethnic composition of the household is water quality. We expected a positive impact; poor land and input quality suggests a lower return to agriculture, which should encourage migration out of Chitwan, as it has done in the hilly regions of Nepal (Maharjan et al. 2012). The negative impact of poor quality agricultural inputs on the number of migrants could be one of two things: poor quality inputs reduce the ability of households to meet the costs of migration or it produces more uncertainty about leaving household members behind.

Using this data, we construct a sample of 850 observations, including college age household members. We found a large number of students attending college and universities in

this district.[12] *In order to understand the impact of migration on schooling differences across ethnic groups, we restricted the sample to 747 observations—some households felt uncomfortable revealing information about caste.* We found few influences on educational outcomes that applied universally in the literature; we partially attribute it to the number of educational outcomes: children's likelihood of quitting school, school enrollment, years of schooling, and percentage of school-age children attending school.

Table 5.2. Determinants of migration at the household level using Poisson Regression

Migration	Coefficient		Robust Standard Error
Male Education	0.00		0.01
Female Education	-0.01		0.00
Income	0.00		0.00
Household Size	0.24	***	0.04
Dependents	-0.14	***	0.05
Owned Land	-0.03		0.04
Caste			
Low Caste	-0.38	*	0.23
Mongolian	-0.16		0.13
Tharu (Indigenous)	-0.29	**	0.13
Water Quality	-0.24	**	0.14
Soil Quality	-0.42		0.31
Migration Experience	0.27	***	0.06
C	-1.11	***	0.20
Number of Observations	358		
Pseudo R-Square	0.25		

Note: ***, **, and * denote significance at 1%, 5%, and 10% respectively.

It is unclear whether we can conclude anything regarding the influence of remittance receipts on actual education investments, so the dependent variable of interest in our study is the yearly expenditure on a child's education (I_i) in 2012. It is a variable ranging from 0 to $8800, with the average yearly per child expenditure on education in Chitwan being $124.68. Using per student expenditures is consistent with previous research that considers educational investments (Grigorian and Melkonyan 2011). We follow the literature (Rozelle et al. 1999; Quinn 2009; Grigorian and Melkonyan 2011; Bansak and Chezum 2009; Carletto et al. 2011, Amuedo-Dorantes et al. 2010) by using an instrumental variable approach to account for the endogeneity problem. The results from the Hausman-Wu test for endogeneity are discussed in

[12] There are five main institutions in Nepal that provide a Bachelor's degree (3–5 years), a Master's degree (another 2–3 years), and a Ph.D. (an additional 3 years), but there are many who leave the country for higher studies (Williams 2009).

the results section, but there are an additional two variables we present that are both explanatory and dependent variables in the analysis: the number of individuals (over the age of 12) from household *i* who left the home in the previous year[13] (M_i) and the average amount of monthly remittances in US$ received by the household in the previous year (R_i).[14]

The explanatory variables used in the paper consists of vectors X_i, Z_i, and W_i, with variables in X_i being the socio-economic characteristics of the school-aged member and household, such as age, total years of education for household males and females, household size, the number of dependents, proportion of males in the household, monthly income, and total size of owned land in hectares. The vector X_i also includes dichotomous variables indicating the gender and marital status of the household member, and caste. The vectors Z_i, and W_i are instrument variables that are used to identify both M_i and R_i, but are not correlated with the yearly expenditure on a household member's education I_i. The instrument variables explain both M_i and R_i without explaining I_i. The variables in Z_i are the number of migration experiences and the number of households in the community that participate in migration, which was obtained from GON's National Population Housing Census (2011) and the variables in W_i are the numbers of houses owned by household *i* and whether or not remittances was used to finance land and house purchases. The descriptive statistics of the variables used are in Table 5.3.

Table 5.3. Education, descriptive statistics by household, Chitwan 2013

Variable	Description	Mean	Standard Deviation
Migrants	# of household members who lived away	1.38	1.66
Remittances	average monthly remittances received in US$	190.59	333.03
Education	yearly expenditure on child's education in US$	124.68	378.20
Income	average monthly income minus remittances in US$	280.43	637.58
Age	age of school-age household member 5 to 23	15.32	5.37
Male	school-age household member is male (0/1)	0.47	0.50
Married	school age household member is married (0/1)	0.13	0.34
Caste	High Caste (base) Low Caste (2) Mongolian (3) Indigenous (4)	2.10	1.22
Male Education	years of education of all household males	25.02	13.72
Female Education	years of education of all household females	20.04	15.25
Household Size	# of household members	6.46	2.78
Dependents	# of household members under 12 and over 65	1.47	1.39
Proportion of Males	proportion of males in the household		
Owned Land	total # of hectares owned by household	1.13	4.16

There are expected signs for the variables in X_i. The more educated the household (male and female education), the more they will invest in education, and since lower-caste

[13] The age of 12 was selected to capture individuals who would have participated in household production had they lived at home.

[14] We did not use a dichotomous variable for whether remittance was used to finance children's education (Quinn 2009) due to fungibility reasons—remittances can be used for various purposes.

households have generally fared with lower levels of education, we expect caste to have a negative association with schooling investments. Age has had both a negative (Acosta 2011) and a positive association (Amuedo-Dorantes et al. 2010) with school enrollment, but we expect school expenditures to increase with higher levels of education. These studies also found that female children were more likely to be enrolled in school than male children; however, Bansak and Chezum (2009) found the opposite in Nepal. We expect households in Chitwan to invest more in their unmarried and male household members because Nepal is a patriarchal society where female children become a part of another household while male children remain at the groom's parents once married (Williams 2009).

Along the same logic, we expect that the expenditure on a school-aged member's education will increase for households with more males. Households with more males are more financially secure as more household labor is available to earn cash. They are also less vulnerable because they can better share risks. We expect the expenditure on education to decrease with increasing household sizes (due to female and dependents) and greater numbers of children and elderly. The congestion effect is also found in El Salvador and Haiti (Acosta 2011, Amuedo-Dorantes et al. 2010). We expect income and hectares of owned land (proxy for household asset) to have a positive impact on the educational outcome. Wealthier and larger landowners may have more resources and the incentives to pay higher costs for quality education.

Methodology

A common problem in estimating any impact of migration in household behavior is that unobserved household characteristics may be correlated with both the outcome of interest and the likelihood of migration. Similarly, remittances should not be viewed as exogenous; households with more migrants should receive more remittances. Migrant families are also not randomly selected among a particular community; selection issues can pose identification problems. While one equation assumes all variables on the right hand side are exogenous, and a two-stage least squares (2SLS) technique addresses the problem, we are unable to study both migration and remittance together. We applied a three-stage least squares (3SLS) technique to estimate migration and remittances simultaneously. The conceptual model is adopted from Rozelle (et al. 1999), Quinn (2009), Grigorian and Melkonyan (2011), and Bansak and Chezum (2009).

First, consider that the household chooses the number of migrants to send out (internal and international):

$$M_i = \beta_o + X_i\beta_1 + Z_i\beta_2 + \epsilon \qquad (1)$$

where X_i is the vector of household characteristics, which includes household demographics, human capital and physical capital variables, and Z_i is the vector of instruments used to properly identify M, and ϵ are the error terms. The individual household is denoted by i=1, 2 ,3, …, n.

Given the number of migrants, they will make the decision on the amount to remit, R. It is determined as:

$$R_i = \alpha_o + X_i\alpha_1 + \widehat{M}_i\alpha_2 + W_i\alpha_3 + \epsilon \qquad (2)$$

where X_i is the vector of household characteristics, $\widehat{M}_i$ is the predicted value from the first equation, and W_i is the vector of instruments to properly identify R.

Finally, the household will choose the expenditure on each household member's education:

$$I_i = \delta_o + X_i\delta_1 + \hat{R}_i\delta_2 + \widehat{M}_i\delta_3 + \mu' \qquad (3)$$

where the predicted values $\widehat{M}_i$ and $\hat{R}_i$ from the first two equations are included in the investment equation. So, the number of individuals from household *i* who lived away in the previous year M_i and average monthly remittances received R_i, are two variables that are both explanatory variables and dependent variables. The three-stage approach equations:

$$M_i = \beta_o + X_i\beta_1 + Z_i\beta_2 + \epsilon \qquad (1)$$

$$R_i = \alpha_o + X_i\alpha_1 + \widehat{M}_i\alpha_2 + W_i\alpha_3 + \epsilon \qquad (2)$$

$$I_i = \delta_o + X_i\delta_1 + \hat{R}_i\delta_2 + \widehat{M}_i\delta_3 + \mu' \qquad (3)$$

Results

Testing for Endogeneity and Instrument Validity

We formally test for endogeneity, and the results from the Hausman-Wu test support the choice to use an instrumental variable approach instead of OLS. The null hypothesis of exogeneity of migration and remittances in the technology regression can be rejected at the 95% confidence level; the t-statistic on the individual residual variables are 2.64 and -1.56, respectively. However, when there is more than one variable being tested for endogeneity, the test is an F-test of joint significance (Hill pg. 421). We also test the instruments for validity. A valid instrument must significantly impact $\widehat{M}_i$ and $\hat{R}_i$ and be uncorrelated with the education regression error term. The tests of joint significance of the instruments in the migration and remittance equations yield an F-test statistic of 46.41 and 13.04, respectively. To reject the hypothesis that the instruments are weak or that the true value of the instruments are zero, the rule of thumb is that the F-test statistic should be greater than 10 (Hill pg. 414). The instruments pass the first condition. We use the Sargan-Hansen test to determine whether the instruments are uncorrelated with the error term, and that the instruments are correctly excluded from the estimated equation. The null hypothesis is that the instruments are valid, and we fail to reject the null for the variable vectors Z_i, and W_i with a chi-square value of 0.00 and 3.19. These result in p-values of 0.97 and 0.20, respectively.

Summary of Results—Third Stage

The results of the estimation of equation (3) using robust standard errors are presented in Table 4. We do not find that out-migration negatively impacts the educational education outcome as other studies have found, but found the opposite effect. Grigorian and Melkonyan (2011) also found that migration positively impacted school expenditures in Armenia. One possible reason for this finding is that Chitwan has a large number of schools, both public and private, and the availability of easily accessible schools may help to minimize the disruptive effect of household member out-migration. Other comparative studies found that male and female migration both positive and negative impacts on school enrollment, respectively, but after accounting for the endogeneity problem, only female migration negatively impacted school enrollment rates, and then only among younger children (6-11 year olds) (Acosta 2009).

Table 5.4. Education, results of third stage regression

Education		Coefficient		Robust Standard Error
Age		3.41		5.90
Male		-16.23		40.94
Married		-126.51	**	56.60
Education of Males		2.76		1.88
Education of Females		9.91	*	5.24
Income		-0.02		0.04
Household Size		-76.81	**	39.76
Dependents		35.56		30.41
Proportion of Males		395.58	**	177.03
Owned Land		4.66		5.79
Caste				
	2	-59.09	***	23.72
	3	-47.46	*	25.19
	4	-23.22		34.86
MHAT		91.84	*	54.92
RHAT		-0.22		0.16
C		61.87		107.47
Number of Observations		747		
Chi-Squared		76.01		

Note: ***, **, and * denote significance at 1%, 5%, and 10% respectively.
R-Square is not applicable in 3SLS

There were also peculiarities that should be mentioned; many survey respondents in Chitwan felt uncomfortable admitting any child contribution to household activities. This may

owe more to the influence of government policy, NGO, or other research institutions in Nepal—we found pictured billboards encouraging study and no child labor in several visible locations. Education indicators may be subject to measurement error—some households may overstate educational expenditures and understate child contribution to household activities to conform to public pressure.

The coefficient on remittance is negative and insignificant. Indirectly this suggests that remittances do not help relax credit constraints in order to invest in human capital formation for families left behind. The negative sign is consistent with the findings in Armenia (Grigorian and Melkonyan 2011). Even households with more income (excluding remittance) are choosing not to invest in more education. The coefficient is small and negligible, but it is negative. It is interesting to note that the lower castes and Mongolian households received on average larger monthly remittances, while the Tharu households with larger landholdings, earned larger incomes. Gurungs, one of the Mongolian ethnicity groups found in Nepal, have traditionally served in the British and Indian armies, migrating for years at a time (Thieme and Wyss 2005).

The coefficient on total female education in the household is positive and significant, which is consistent with findings in other studies. Educated women invest in children's education. These results may indicate that gender inequality is slowly deteriorating; especially if coupled with our finding that gender is insignificant—male children are not being preferred to female children as other studies have suggested (Bansak and Chezum 2009, Amuedo-Dorantes et al. 2010). It used to be that women had little control over household expenditure allocation. If the female population becomes more educated in Nepal, we should expect to see greater opportunities for women, like trading, which may involve travel away from home. Williams (2009) found that women from Chitwan are participating in migration in greater numbers, and she attributes it to the education levels of female populations.

The presence of more males in the household (proportion of males) also results in larger investments in education, as we expected. This is different from what Grigorian and Melkonyan (2011) and Acosta (2009) found in Armenia and El Salvador—the proportion of females and the number of females improved educational outcomes. Educated women may be contributing to household expenditure allocation, but males still earn more than females in Nepal and are considered the main cash-income earners (Gartaula et al. 2012, Thieme and Wyss 2005). Following the factors that negatively impact educational outcomes the most—household size and marital status—the ethnic composition of the household plays a significant part in the household's decision-making process and investments in human capital formation.

Conclusion

As the importance of labor migration and the subsequent impact on households has come to the foreground of development research, it is important for researchers to make clear the uncertainties concerning some of the benefits and pitfalls for rural economies. Nepalese migrants transfer a significant sum of remittances to their communities of origin, so the paper uses data from Chitwan, one of the most agricultural developed districts in Nepal, to test the implications of migration and remittance flows on the behavior of receiving households, specifically children's schooling. We found that monthly remittances have no impact on the household's expenditure on education, but migration has a significant and positive one. Policy

makers interested in improving the education levels in Nepal may need to target households receiving the most remittances.

First, not all households in Nepal are able to afford the related expenses of migration, especially to international destinations. There are inherent disadvantages facing lower-caste and ethnic groups, and even if lower-caste households find the collateral to finance migration, they may not be spending their remittances on productive investments. They may invest the money to repay a debt, build a house, or purchase land. Subsequently, there may be a long-term differential consequence that migration of different population groups generates. It should not be expected that investment in children's education, as a livelihood strategy, will gradually spread to the more disadvantaged society members (Thieme and Wyss 2005, Adefila 2012, Mendola 2007, Frost et al. 2007, Nepal FY, Yang 2011).

Policies should aim to enhance the contributions made to the educational attainment of all ethnic groups in Nepal, especially in the rural parts of the country. They should consider the limitations of remittance in that endeavor, for example, if households are starting at very low consumption levels. However, if the daily consumption requirements are met, policies and training may help optimize the remittance potential for education levels. Education levels have been found to contribute to an increase in agricultural production (Pudasaini 1983) and agricultural technology adoption (Mgbenka et al. 2012; Firdaus and Ahmad 2010; Bansak and Chezum 2009; Agrawal and Gupta 2005), which may have grave implications on the country's long-run food security. Agrawal and Gupta (2005) also found that higher education might open up opportunities for educated individuals to work outside Chitwan, reducing household's dependence on natural resources.

CHAPTER 6
GENERAL CONCLUSIONS

As the importance of labor migration and the subsequent impact on households has come to the foreground of development research, it is important for researchers to make clear the uncertainties concerning some of the benefits and pitfalls for rural economies. Nepal, a land-locked country with limited resources, was the perfect country to study all the facets of migration, remittance, and their impact on sustainable development. With the arrival of multiparty democracy, the Government of Nepal (GON) began encouraging migration to reduce poverty, unemployment, and provide economic opportunities outside of farming. This has resulted in a better economic status for a number of rural households, weakening the incentives to participate in agriculture (Williams 2009). Formidably, there still remain a large percentage of households that depend on agricultural and natural resources, and this thesis explored some of the consequences of bourgeoning out-migration.

The outcomes of interest included household adoption of agricultural technology and conservation methods and per child expenditures on education. The thesis offers an analysis of both migration and remittance flows, and it adds to the literature by exploring the impact on the behavior of receiving households in Chitwan, one of the most agriculturally developed districts in Nepal. It addresses a common problem found in the migration literature: unobserved household characteristics are correlated with both the outcome of interest and the likelihood of migration. We account for the endogeneity of migration, remittance, and the investment outcomes using an instrumental variable approach that allows us to estimate migration and remittances simultaneously. Migrant families are not randomly selected among a particular community, and neither are the households that receive remittances. Future extension of this work will use a count data model in addition to considering the endogeneity issue.

Using a three-stage least squares (3SLS) technique, we found the number of migrants in a household had a significant and positive impact on the number of agricultural technologies adopted and yearly per child education expenditures. However, it had a significant and negative affect on the number of conservation methods adopted. We suggest that policy makers interested in increasing the number of conservation methods adopted may need to secure greater participation by those most dependent on agriculture and those who have the available funds to invest in the agricultural infrastructure of this country. The labor scarcity in Nepal may become severely constraining for sustainable agricultural development if conservation methods remain labor intensive.

Fortunately, the large numbers of underemployed and unemployed working age adults who left Nepal are transferring a significant sum of remittances to their communities of origin, making up to 25.83% of GDP (Nepal Bastra Bank 2014). While insignificant, remittance has a positive effect on the number of conservation technology adopted. If remittances could be somehow channeled toward natural resource conservation, it may be possible to meet the objectives of distributing the benefits of increased income levels to the most vulnerable people in society.

There also exists a cultivation practice that is not labor intensive, so migrant households could chose to adopt them at a greater rate due to the minimal labor requirements (FAO 2008, FAO 2012). Conservation Agriculture (CA) is a sustainable and an environmentally friendly management system that includes practices such as minimum tillage, improved crop varieties, intercropping, and the use of cover crops (Laia et al. 2012). Optimistically, Nepal's Feed the Future program is utilizing CA as part of their country investment plan. The problem is that they may encounter the poverty-trap and mindset that is accelerating environmental degradation in other parts of the world. We corroborate the findings that suggest education should be a predetermining factor in the assimilation of information and technological adoption of CA among more vulnerable farmers in Nepal (FAO 2008, Nepal FY, Adefila 2012, Mendola 2007, Frost et al. 2007).

However, we warn that policies encouraging education should aim to enhance the contributions made to the educational attainment of all ethnic groups in Nepal, especially in the rural part of the country. They should consider the limitations of remittance, for example, if households are starting at very low consumption levels. If the daily consumption requirements are met, policies may help optimize the remittance potential. Not only is education a predetermining factor in information assimilation and technological adoption among farmers, it may help household members access better jobs (Pudasaini 1983, Lai et al. 2012, Firdaus and Ahmad 2010, Ebojei et al. 2012, Mgbenka et al. 2012). Clearly, information and knowledge help the poor avail of the opportunities presented to them.

The effective dissemination of information is also crucial, and cooperative organizations that spur communal effort, provide training, and disseminate information may be one way of imparting new ideas and agricultural technologies in Nepal (Agrawal and Gupta 2005, Adeola et al. 2011, Adefila 2012, Kolawole et al. 2012, Mgbenka et al. 2012). Community and agricultural development agencies have found these organizations to be effective in imparting new ideas, techniques, and harnessing communal resources towards improving agricultural production in other countries. It could be a source of information to educate migrant households about using remittances for productive investments, to adopt agricultural technology or conservation methods (Alam et al. 2008, Akteruzzaman et al. 2008, Firdaus and Ahmad 2010, Adeola et al. 2010, Mgbenka et al. 2012, Ahmed et al. 2012, Ebojei et al. 2012, Laia et al. 2012).

Nepal already has decentralized community-level user groups in the Chitwan Valley and agricultural cooperatives have a longstanding history in Nepal. Membership in such groups has been shown to improve natural resource management. For example, villagers living next to the protected national forest established in Chitwan in 1973, participate in user-groups which meet to contribute to savings, and based on a rotation scheme, draw loans at collectively decided interest rates. The households living in these protected regions build infrastructure and contribute to afforestation programs, thereby reducing poverty and household dependence on natural resources (Agrawal and Gupta 2005). The channel for the dissemination of sustainable agricultural practices is already in place, and its importance in Nepal's agriculture sector has been emphasized in the current budget 2014/2015 (Nepal Ministry of Finance 2014).

Unless appropriate policies are implemented, we believe migrant remittances will be used mainly for consumption, with very little being used for sustainable investment or worse, may contribute to the degradation of an already vulnerable environment (Maphosa 2007, Lez-Vega et al. 2004, Massey et al. 2010). For example, we found that processed consumer goods

are becoming a serious problem in Nepal and the situation may become worse in the future.[15] This study helps put the determinants of adopting resource-conserving technologies in a migration context, and therefore hope to facilitate better policy design. With adequate policies to encourage CA, for example, agricultural development could converge with natural resource conservation, allowing migration and remittance to be a catalyst for sustainable agricultural development in rural Nepal. Our findings can also be viewed in relation to studies in other parts of the world to gain a better understanding of the impact of migration and remittance, especially on the rural poor who are vulnerable to environmental hazards.

[15] It was observed during field study, that the Nepalese already regard pollution levels to be a problem, and many appear to participate in a silent protest by wearing facemasks to inhibit the inhalation of dust. Consuming commodities that are not made at home are affecting waterways; a distressing level of trash and waste is filling the streets and rivers.

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APPENDIX A
ADDITIONAL TABLE

Education, results of the first and second stage regressions

	Migration			**Remittances**		
	Coefficient		Robust Standard Error	Coefficient		Robust Standard Error
Age of Head	0.02	***	0.00	-4.02	***	1.15
Male Education	0.00		0.01	6.51	***	1.67
Female Education	0.00		0.00	3.24	**	1.54
Income	0.00	*	0.00	-0.07	***	0.02
Household Size	0.33	***	0.04	-91.89	***	19.83
Dependents	-0.12	**	0.05	40.87	***	10.81
Owned Land	-0.05	***	0.01	9.50	***	3.04
Caste						
Low	-0.19		0.15	94.55	**	44.53
Mongolian	0.12		0.12	28.64		32.10
Tharu (Indigenous)	-0.08		0.13	31.09		46.80
Water Quality	-0.51	***	0.10	101.19	***	38.11
Soil Quality	-0.59	***	0.15	64.38		40.16
Migration Experience	0.44	***	0.06			
Participate	0.00		0.00			
MHAT				233.92	***	32.66
Houses				158.12	***	42.65
Financed Land				96.75	***	35.58
Financed House				6.20		38.74
Number of Observations	747			747		
Chi-Squared	1011.03			407.00		

Note: ***, **, and * denote significance at 1%, 5%, and 10% respectively.
R-Square is not applicable in 3SLS

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For Internal Use:

[redacted]

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[redacted]

M	F	Code	Code	Code	Code
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M	F	Code	Code	Code	Code

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(Rupee)

Yes No Unk	Code	Yes No Unk	Code	Code	Code
Yes No Unk	Code	Yes No Unk	Code	Code	Code
Yes No Unk	Code	Yes No Unk	Code	Code	Code
Yes No Unk	Code	Yes No Unk	Code	Code	Code
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Yes No Unk	Code	Yes No Unk	Code	Code	Code
Yes No Unk	Code	Yes No Unk	Code	Code	Code
Yes No Unk	Code	Yes No Unk	Code	Code	Code

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(Rupee)

Code	Code	Code	Code
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Code	Code	Code	Code
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Code	Code	Code	Code
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Code	Code	Code	Code
Code	Code	Code	Code
Code	Code	Code	Code

Yes No Unk	Yes No Unk	Yes No Unk	Code	Yes No Unk	Code
Yes No Unk	Yes No Unk	Yes No Unk	Code	Yes No Unk	Code
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Yes No Unk	Yes No Unk	Yes No Unk	Code	Yes No Unk	Code
Yes No Unk	Yes No Unk	Yes No Unk	Code	Yes No Unk	Code

[redacted]

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(Rupee)

Yes No Unk	Yes No Unk	Yes No Unk	Code	Yes No Unk
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[redacted]

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(Rupee)

Yes	No	Unk	Yes	No	Unk	Yes	No	Unk
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Yes	No	Unk	Yes	No	Unk	Yes	No	Unk
Yes	No	Unk	Yes	No	Unk	Yes	No	Unk
Yes	No	Unk	Yes	No	Unk	Yes	No	Unk
Yes	No	Unk	Yes	No	Unk	Yes	No	Unk
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[redacted]							(Rupee)			
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Yes No Unk				
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Yes No Unk			Code	Yes No Unk
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Yes No Unk
Yes No Unk

Yes No Unk

(Rupee)

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Yes No Unk

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Yes No Unk

Yes No Unk

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(Rupee)

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Yes No Unk	Code	Code	Code
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(Rupee)

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(Rupee)

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M F	Yes No Unk	Yes No Unk	Code	Yes No Unk	Yes No Unk	Yes No Unk

[redacted]

[redacted]

[redacted]

Help on your first trip:	Use these two columns if the household head is a migrant		Collect only if household head is NOT a migrant
	Code	Code	Code
(Rupee)			
(months)			
	Code	Code	Code
	Code	Code	Code
	Yes No Unk	Yes No Unk	Yes No Unk
	Code	Code	Code
Information about your last trip			
	Code	Code	Code
If got a job, how long did it take to get your job?			
If got a job, how many hours did you work per week?			
If got a job, which months did you work? *d* (All that apply)	Code	Code	Code
How many times did you communicate with household in home country?			
How many times did you send money to household in home country?			
How much **total money** did you send to household in home country? (Rupee)			
	Yes No Unk	Yes No Unk	Yes No Unk
	Yes No Unk	Yes No Unk	Yes No Unk

[redacted]

[redacted]

(Rupee)

(Rupee)

Code	Yes No Unk		Code
Code	Yes No Unk		Code
Code	Yes No Unk		Code
Code	Yes No Unk		Code
Code	Yes No Unk		Code

[redacted]

(Rupee)

(Rupee)

Code	Yes No Unk	Code		Code	Code
Code	Yes No Unk	Code		Code	Code
Code	Yes No Unk	Code		Code	Code
Code	Yes No Unk	Code		Code	Code
Code	Yes No Unk	Code		Code	Code

[redacted]

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[redacted]		Code	Code	Code	Code	Yes No Unk	Code	Code
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				(Rupee)
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[redacted]

(Rupee)

[redacted]

(Rupee)

[redacted]

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[redacted]

Often Sometimes Never NA
Often Sometimes Never NA
Often Sometimes Never NA
Often Sometimes Never NA
Often Sometimes Never NA
Often Sometimes Never NA
Yes No NA

Code

Yes No NA
Yes No NA
Yes No NA
Yes No NA
Code

Yes No NA
Yes No NA
Yes No NA
Code

Yes No NA

[redacted]

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[redacted]

Often Sometimes Never NA
Often Sometimes Never NA
Often Sometimes Never NA
Often Sometimes Never NA
Often Sometimes Never NA
Often Sometimes Never NA
Yes No NA

Code

Yes No NA
Yes No NA
Yes No NA
Yes No NA
Code

Yes No NA
Yes No NA
Yes No NA
Code

Yes No NA

[redacted]

[redacted]

(Rupee)

(Rupee)

Yes No Unk	Code	Code	Yes No Unk
Yes No Unk	Code	Code	Yes No Unk
Yes No Unk	Code	Code	Yes No Unk
Yes No Unk	Code	Code	Yes No Unk
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VITA

Deborah Williams was born in Brazil in the early 1980's where she first witnessed abject poverty. She has volunteered and worked with the poor since graduating from high school, at every opportunity encouraging young and old to pursue education, believing that knowledge is one's most valuable asset. She has advocated for the poor by helping in food pantries, community clean ups, and inner city camps reaching at risk children and youth. She helped run an after-school program for vulnerable children attending a charter school in a poor area of Dallas, Texas. Her first full time job after graduating from college was helping ex-offenders find employment in North Baton Rouge. Not only has she worked to fight poverty in urban areas of Texas and Louisiana, but she has also traveled to other countries like Jamaica, Mexico, and Israel, on short-term trips aiding the countries' poor with food, clothes, and medical care. It was not until her one and half year experience living and working with an indigent village in southern Mozambique that she committed to pursue graduate studies.

She has an interest in international development, and aims to return to an impoverished community overseas in order to design education programs that promote sustainable human development. She will be completing her masters of science in December of 2014. She took six months leave from her graduate studies to direct an anti-human trafficking project leading up to the 2014 World Cup. Her work experience overseas has helped build important networks for future development work, but it has also encouraged her to pursue further studies. She will be devoting three additional years to learning how to solve economic problems as a PhD student in the Agricultural Economics Department at LSU. She wants to gain a cross-disciplinary understanding of development by supplementing her history and political science education, with an in-depth economic perspective. LSU's extensive international exposure provides her invaluable information about rural development, complimenting her career goal to design education programs promoting rural development overseas.