Migration decision-making under environmental change: Place utility, mobility and ecosystem services in highland Peru

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Abstract

Migration is often conceptualised as a failure to adapt to environmental risks and change, while new research suggests migration is an effective front-line response to environmental degradation. This thesis investigates the social and environmental mechanisms that lead to individuals adopting migration as an adaptation to environmental change. It argues that the use of migration as a response to environmental change depends on the ecosystem services available at location, the mobility characteristics of the individual and the degree to which ecosystem contribute to place utility. I interpret place utility as a function of both instrumental and affective bonds to place.

The research tests these ideas in a highland migrant sending area in a small coastal valley of Peru, geographically and culturally connected to the capital city Lima but predominantly rural in nature. The area has established rural-urban migration networks and a complex social-ecological system vulnerable to climate change. Data on mobility characteristics, contributors to place utility and use of ecosystem services in the rural sending area were collected through household surveys and semi-structured interviews. Four settlements were sampled along an altitudinal transect representing different ecological zones as well as different access to off-farm employment and other opportunities.

Analysis of the primary data shows that individuals gain utility from non-provisioning ecosystem services independently of reliance on provisioning ecosystem services. These impacts of climate change that previously only had a cultural significance take on significance in terms of migration. The data show that individuals remain in location because of positive place utility or low mobility potential. I conclude that a likely result of environmental change is an increase in dissatisfaction with no significant changes in the composition of the population. Low mobility potential, a function of affective bonds to place, prevents dissatisfied people from migrating. The thesis shows that populations are likely to be persistent in the face of environmental change. Understanding why individuals remain in location reveals the viability of migration as an adaptation to environmental change.

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1 Introduction

This thesis investigates the likelihood of migration as a response to environmental change and how the likelihood varies within and between populations. I argue that variation in the use of migration as a response to environmental change is a combination of three factors: differences in ecosystem services available at location; internal differentiation among a population with respect to mobility; and variation in how people gain utility from their environment. I interpret place utility as a function of both instrumental and affective bonds to place.

1.1 Climate change and migration

Research at the nexus of the environment, environmental change and migration has come of age as a field reflected in the release of the results of major syntheses such as the Each-For Project (Warner, Afifi et al. 2011), the Foresight Report on Migration and Global Environmental Change (Foresight 2011) and anthologies on the topic (Piguet, Pécoud et al. 2011). The emerging research in this field contributes to wider understanding of human-environment interactions and draws a line under ill-informed and alarmist research of the past (Suhrke 1994; Gemenne 2011), where migration motivated entirely by climate drivers is considered a distinct possibility (Myers 1997; Myers 2002).

This new wave of empirical research acknowledges that the environment is only one of many drivers that act to create migration (Castles 2002; Black, Adger et al. 2011; Warner, Afifi et al. 2011), and that environmental change acts on an already mobile world (Black, Kniveton et al. 2008; Tacoli 2009; Black, Adger et al. 2011). Recent research in the field has investigated the effect of the environment among social predictors quantitatively through multivariate studies in a variety of settings. Empirical evidence shows that environmental change leads to both increases and decreases in migration depending on the context (Ruitenbeek 1996; Henry, Piché et al. 2004; Henry, Schoumaker et al. 2004; Massey, Axinn et al. 2007; Gray 2010; Bohra-Mishra and Massey 2011; Gray 2011; Kniveton, Smith et al. 2011; McLeman and Ploeger 2011; Gray and Mueller 2012). The nature of the relationship between environmental change and migration depends on specific interactions of socio-economic, demographic and geographic characteristics of place, the nature and geographic and temporal scale of the environmental change and the kind of mobility response examined. Therefore, although research has established that there is an association between the environment and migration, the nature of that relationship remains highly context-specific.

Another feature of this new wave of environment-migration research is that the environment is re-established as one of the important drivers of migration which itself can be affected by climate change. Authors acknowledged this fact in the 1990s, only for it to be forgotten and re-introduced into theory by the (Suhrke 1994; Lonergan 1998; Black, Adger et al. 2011). The role that the

environment plays in migration exists on a continuum from emergency displacement due to extreme weather events to economic migration. Some people will migrate as daily activities become more of a drain on time and resources. For example, people were found to migrate locally due to an increase in time spent search for fodder and firewood (Massey, Axinn et al. 2007). Others will passively remain in the area until it is completely degraded and starvation, government relocation or relief are required (Suhrke 1994).

Research to date has tended toward an impacts-driven, top-down approach that identifies case studies through the presence of a strong climate signal. For example, the Each-For project identified locations where both migration and environmental change were present to see if an environmental change signal was identifiable in the migration that was occurring(e.g. Warner, Afifi et al. 2011). The climate impacts most often studied in relation to migration are sea level rise, extreme events and drought.

Although sea level rise, by definition, must lead to displacement due to inundation, the timing is complicated by social factors. Certain coastlines will almost certainly be protected such as the financial centres of large cities (Nicholls, Tol et al. 2008) and the success of a population in adapting to changes in their coastal zone depends on their attitude to environmental change (Oliver-Smith 2011). Conversely, salt water intrusion, repeated storm surges, and increased land erosion is likely to lead to emigration long before land is inundated (Arenstam Gibbens and Nicholls 2006). Extreme events are associated with short-term short distance migration; people undoubtedly return, and due to the presence of aid organisations and reconstruction work sites, natural disasters can act as centres of immigration (Paul 2005; Piguet, Pécoud et al. 2011). Less well investigated is endurance of repeated storm surges, floods or hurricanes before people are motivated to relocate permanently (Kartiki 2011). Precipitation deficit and drought is associated with increases and decreases in mobility depending on whether the migration is long or short distance, gender and the level of economic, social and natural capital of the migrant (Henry, Schoumaker et al. 2004; McLeman and Smit 2006; Gray 2010; Gray 2011).

However, a more effective approach to researching migration in climate change hotspots, may be to look at migration hotspots; identify places where there are well-established migration flows and determine what factors encourage or inhibit mobility in these situations. The sensitivity of these drivers to environmental change can then be investigated (Black, Kniveton et al. 2008) and the mobile nature of most societies recognised (Black, Kniveton et al. 2008; Tacoli 2009).

This thesis focuses on depopulation of highland areas; both a historic phenomenon and a current demographic trend across the globe (Williams and Griffin 1978; Devine 1983; O'Rourke 1999; Arnaez, Lasanta et al. 2011). Highland populations persist despite depopulation and mobility is vital to maintaining livelihoods in these marginal areas (Bebbington 1999; Grau and Aide 2007). It

is in this context that this research takes place, understanding why rural populations persist despite strong pull factors and established migrant networks. Will rural populations be able to persist in the face of changes to the climate?

1.2 'Darkening peaks', migration and ecological heterogeneity: Peru as a hotspot for environmental migration

'Darkening peaks' is a reference to Ben Orlove's work on glacial retreat and its physical and cultural significance for populations both proximate and distal to the glaciers (Orlove, Wiegandt et al. 2008). Tropical glaciers, due to their small size and location, are especially vulnerable to climate change. Their retreat is rapid, well documented and has accelerated over the last decades of the 20th century (Francou, Vuille et al. 2003). Some of the smaller glaciers have already disappeared and others are expected to be gone in decades (Rhoades, Rìos et al. 2008).

Tropical glaciers act as a freshwater 'buffer' during the dry season: catchments with larger glaciated areas show less variation in river flow from the wet season to the dry season (Mark and Seltzer 2003; Barnett, Adam et al. 2005). Glacial retreat leads to greater intra-annual variability in stream flow with implications for irrigated agriculture and hydroelectric power generation.

Twenty-six per cent of the world's tropical glacier area is in the Cordillera Blanca in Peru (Kaser and Osmaston 2002). Countries such as Peru have been developing their economies rapidly in recent years, based on unsustainably high river flows from the rapid melting that has occurred over the past few decades (Mark and Seltzer 2003). Contributions of melt water to stream flows have peaked and societies downstream of these glaciers now face an altered hydrological regime.

Mountain regions provide a useful arena in which to study the way in which ecosystems influence the development of social systems. A huge range of microclimates and ecological zones characterise the Andes range, created by rapid increases in altitude over short distance and the existence of high altitude areas in a low latitude region. The natural capital of an area changes over short distance in relation to the temperature and precipitation, as well as with geology and slope (Winterhalder 1993). This heterogeneity in the natural environment is matched by, and has engendered, a great socio-economic heterogeneity (Handelman 1975; Golte 2001). The most socially marginalised populations live in the most geographically inaccessible regions. The majority of the population, economic activity and education opportunities are located in the coastal cities.

The combination of these climate, geographic and socio-economic factors has lead to high discrepancies in both the productive capacity of, and level of investment in, agriculture across Peru (Crabtree 2002). The majority of the irrigated land and investment in modern agriculture is on the coastal plain and in coastal valleys (Crabtree 2002; Edmeades, Janssen et al. 2008). This in

turn has created a migration flow from the Andes to the coast and urbanization has been the dominant trend over the latter part of the twentieth century.

This research on environmental change and migration takes place in the coastal highlands of Peru since it is a location where social and ecological factors converge particularly acutely. The farming communities are some of the most privileged in Peru in that they have access to irrigation. Yet, unlike the large coastal farmers who irrigate the desert to grow export crops, they are forced to co-exist with the climate vagaries, steep slopes and range of ecosystem services that accompanies life and agriculture in the Andes.

The valley where this work takes place, that of the Rímac River, is significant in that it is one of the three valleys that supplies the capital city of Lima with its water and hydro-electricity. Migrants that migrate to Lima because of water shortages are relocating within the same hydrological system. The watershed is glaciated at its headwaters, although not extensively, but glacial melt water does contribute to hydroelectricity generation for the capital. The inhabitants note a decrease in seasonal snowpack with sadness; its implications are economic as well as cultural as less snowpack, like elsewhere, translates into less dry season flow for irrigation.

1.3 Moving from the macro to the micro: bringing the environment into migration decision-making

In the same way that neo-classical economic theories are unable to predict migration successfully because of they fail to take into account the role of social and psychological factors in the decision to migrate (and hence the New Economics of Labour Migration), people gain benefit from the environment in ways beyond its ability to provide an income. The health and cultural values of the environment are recognised in the Millennium Ecosystem assessment, the National Ecosystem Assessment, and the literature on limits to adaptation in that adaptation cannot replace the aspects of the natural environment to which people have a cultural and emotional attachment (Adger, Dessai et al. 2009).

Chapter Two of this thesis elaborates a framework based on these insights, focusing on the intersection of environmental change and migration at the level of the individual. The framework is a composite of frameworks from related fields and uses the concept of ecosystem services to bring environmental change into the migration decision-making process through the idea of wellbeing. These theories suggest that the likelihood of migration under environmental change is a function of mobility characteristics; the degree to which, and the way in which, a person gains utility from the natural environment; and characteristics of place.

Black et al. (2008) were among the first scholars to propose looking at the influence of environmental change on existing drivers of migration, instead of looking at the role of

environmental change as a driver of migration. This work differs from traditional demographic approaches since, instead of focusing on the role of environmental change in driving migration, it focuses on the role of the environment, through ecosystem services, in creating the utility that keeps people in location.

Chapter Three discusses the range of approaches that researchers have employed to investigate the relationship between the environment and migration and why a social survey approach is the most appropriate in the case of this thesis. It goes on to further elaborate why Peru is the most appropriate location in which to implement the framework and discuss the specifics of the field site, the Rímac Valley on the central coast.

Each empirical chapter of this thesis addresses one component of the framework using survey data collected from villages along an altitudinal transect in a coastal valley of Peru. Chapter Four addresses the migration decision-making process and the ways in which place utility, mobility and barriers interact to encourage or prevent migration in response to residential stress. Chapter Five investigates the contribution of ecosystem services to place utility and defines the members of the population with the highest levels of ecological place attachment. Chapter Six explains differences in the mobility profile of the villages in terms of the socio-ecological characteristics of the settlement and the ways in which the population of the settlement gains utility from the settlement.

To avoid direct questioning about intended future actions, which rarely produces accurate results (Ajzen 1985; Afifi 2011; Black, Adger et al. 2011), place utility and mobility potential provide an assessment of the potential likelihood of future migration. Behavioural theories focus on migration decision-making as a process: stress is experienced, place utility moves from positive to negative and the decision-making process is initiated (Brown and Moore 1970; Speare 1974). The level of stress or dissatisfaction tolerated is inversely related to mobility potential (Lonergan 1998) and so mobility and place utility trade-off against each other in creating the level of stress which a person is willing to tolerate. Place utility is an indication of how much a person likes the place in which they live, 'a positive or negative quantity, expressing respectively the individual's satisfaction or dissatisfaction with respect to that place' (Wolpert 1965; 162). Mobility potential relates to how easy it is for people to move; some people are 'easily movable' while others are 'virtually immobile' (Morrison 1972).

Chapter Four looks at determinants of negative place utility, ways to identify the dissatisfied population and whether dissatisfaction is predictable. It uses the reasons why migration did not take place once considered to shed light on the different phases of the migration decision-making process. Socio-demographic predictors of migration are compared to mobility as defined by behavioural migration theory. Finally, the behavioural migration approach to looking at migration

is put in the context of the household and past mobility behaviour. In this way, a behavioural migration approach is able to reveal the members of the population who are already 'trapped' (Foresight 2011) in location, and the reasons why migration is the adaptation of choice for some members of a population, while for others it will only ever be the adaptation of last resort (McLeman and Smit 2006).

While Chapter Four ascertains how able a person is to migrate, Chapter Five investigates variation in sensitivity to environmental change. The degree to which a change in environment affects a person depends upon the degree to which ecosystem services contribute to their wellbeing.

Through the contribution they make to human wellbeing, ecosystem services provide the critical analytical link between environmental change and migration decision-making. Ecosystem services are "the goods and services provided by ecosystem functions from which human populations derive benefit" (Costanza, d'Arge et al. 1997; 253). Yet there are persistent and pervasive inequalities in access to natural resources (Ribot and Peluso 2003) and social groups within a population benefit to different degrees and in different ways from the same ecosystem services (Daw, Brown et al. 2010). Degradation in ecosystem services cannot affect a group that does not have access to them (Turner, Cakacaka et al. 2007; Daw, Brown et al. 2010). Furthermore, rural locations themselves, as the sending areas in many migration systems, differ in the degree to which their populations depend on ecosystem services for their income (Machlis, Force et al. 1990; Bebbington 1999).

Chapter Five assesses this ecological component of wellbeing through the degree to which a person depends on farming for their income (regulating and provisioning services for agriculture) and the degree to which cultural and health benefits of location feature in their attachment to place. In the terms of behavioural migration theory, although ecosystem services do not form barriers to migration or lead to low mobility potential, they are important in creating place utility, which trades off against barriers and mobility to encourage or inhibit migration.

The population forms a commitment to place, based on the characteristics of life in a rural location, of which ecosystem services form a large part. The data suggest that although ecosystem services do not prevent an individual from leaving, they are common contributors to place utility. Degradation of ecosystem services would therefore cause a fall in place utility, with knock-on effects on the migration decision-making of the population. It may cause people to start the migration decision-making process or move further along within it.

The results show that environmental change will affect the population through both an instrumental attachment to ecosystem services (use of the provisioning services of farming) and through affective bonds to ecosystem services (use of cultural and regulating services). A person

can exhibit one without the other: high instrumental attachment to ecosystem services may is not a prerequisite of high affective attachment to the environment.

Chapter Six explains differences in the mobility profile of the villages in terms of the socio-ecological characteristics of the settlement and the ways in which the population of the settlement gains utility from the settlement. The analysis extends beyond the level of the individual and their household to take into account the geography of the location in which they live; investigating how and why mobility and migration, place utility, ecological place utility and socio-ecological characteristics vary between places.

Analysis at the level of the settlement demonstrates that the unique combination of factors occurring in a specific location leads to a different overall exposure of the population to environmental change and ability of the population to respond to this change through migration. The settlements show distinct patterns with respect to the ways in which the population gains utility from its location, degree of reliance on farming and the past mobility profile of the population.

Differences in place utility, reliance on farming for income and past mobility are ascribed to the size of the settlement, its geographical accessibility and administrative role, availability of land and the ecological zone in which it is located. These interactions have lead to the development of distinct socio-ecological-migration systems. High rates of return migration or high rates of immigration maintain the populations in the area. Populations composed of greater numbers of immigrants are younger, more educated and less stable, making emigration more likely. Populations have different mixes of instrumental and affective bonds to ecosystem services.

The analysis in Chapter Six shows that ecosystem services influence the socio-economic development of a settlement that in turn affects the kind of migration system that forms. Therefore, ecosystem services affect migration in a fundamental way, even before environmental change perturbs the system.

Due to differences in utility gained from ecosystem services, and the different socio-economic systems that have formed, settlements show different propensities for migration under environmental change. The framework, when implemented using data from the empirical study demonstrates five potential migration-decision responses in the population as a result of environmental change: use of temporary migration; a shift in place utility from positive to negative, raise stress thresholds, overcome barriers to migration or no impact on migration decision-making process. The most dominant change observed is not an increase in migration but an increase in dissatisfaction in the population.

Chapter Seven analyses the results of the empirical chapters as a whole and highlights the contribution of the results for environmental migration research. It discusses the implications of the results for the population in the Rímac valley and for the sustainability of rural Peru in general, and returns to the ideas of 'darkening peaks' and their extended significance under the framework. Finally, it discusses the contribution of the thesis to migration theory and our understanding of social processes under environmental change.

1.4 Conclusion

There is already significant evidence that ecosystems and their services provide the natural capital that allows people to migrate or helps them to adapt in location (Ruitenbeek 1996; McLeman and Smit 2006; Gray 2010; McLeman and Ploeger 2011). This research goes beyond direct consumption and wellbeing by suggesting that non-provisioning ecosystem services have a role in creating place utility and hence place attachment. Therefore, a reduction in ecosystem services will have an impact on migration flows through the impact it will have on the place utility of the population. It will do this by bringing people into a dissatisfied state, closer to their stress threshold and to migration.

The research supports the importance of disaggregating any population when looking at the potential for migration to result from climate change, since responses will be socially differentiated. This research demonstrates the usefulness of disaggregating populations not only by their access to different forms of capital or demographic characteristics but by their attitudes to location and the ways in which they form both instrumental attachment and affective bonds to place.

This research demonstrates that ecosystem services, through their role in creating place attachment and providing an income, affect the migration decision. It also shows that use of ecosystem services extends far beyond those reliant on agriculture for income, and research on the potential for climate change to produce migration should recognise this fact. It demonstrates the importance of placing benefit gained from income in the context of wider social and emotional utility gained from location in trying to understand whether environmental degradation will lead to a migration outcome.

The following chapter introduces the literature that supported the creation of the analytical framework which forms the basis for the work. The framework and research questions which emerge from it are then presented. After describing the methodological approach taken, the empirical results from each section of the framework are analysed in Chapters Four, Five and Six. Chapter Seven provides a discussion of the implications of these results for Peru, the sustainability of the rural livelihoods, and compares the results to others from the environmental change and

migration field. The thesis concludes that only by understanding the reasons why an individual remains in location can policymakers implement appropriate responses to environmental change.

2 Conceptualizing migration and the interaction between migration and the environment

2.1 Introduction

Migration, defined pragmatically, is a relocation of primary residence of a person for at least a year or season. Migration takes place over many geographical and temporal scales. Motivations are as diverse as the migrants themselves. Although the most high profile kind of migration, few of the migrations occurring every day, cross a national border. The majority of migrations are within countries, voluntary and are either motivated by life course stages such as education, marriage, retirement and family reunification or related to economic factors. Temporal and spatial scales vary from daily commutes to work and climbs to pastures, to permanent international migration. International migration requires large levels of investment and is predominantly between contiguous countries in the developing world. Internal migration, which is harder to monitor, is usually towards major cities and coasts.

This chapter begins by examining the ways in which scholars have conceptualized the causes of migration at the scale of the individual. I describe three different approaches to understanding migration at this scale: neo-classical economic theories, the New Economics of Labour Migration and behavioural migration theories. The chapter continues by describing three aspects of place utility in a rural setting: sense of place; rurality and rural livelihoods; and ecosystems services – the benefits gained by humans from ecosystems. It then looks specifically at research on migration as an adaptation to climate change.

By identifying the interactions within these bodies of work, the final section of the chapter, presents the analytical framework for this research that combines these elements to assess the likelihood of environmental change to influence the individual migration decision-making process in a rural sending area, and for migration to act as an adaptation to environmental change.

2.2 Theories of migration decision-making

Efforts to understand and predict migration date back to Ravenstein's Laws of Migration based on observations of rural to urban migration during the industrial revolution (Ravenstein 1885). Lee (1966) updated Ravenstein's laws and explained flows through characteristics such as diversity in sending areas and increased diversity in receiving areas, established routes of transport, development processes and decreased intervening obstacles (i.e. better transport routes). Models since have tried to not only explain but predict migration. Usually the models work at a specific scale focusing on intra-urban moves, international flows or cyclical labour migration. The models are complementary not contradictory, but lack transferability to other settings and lack predicative power.

Migration can be defined in many ways through its different temporal and spatial characteristics. Generally, it is classed as a permanent or semi-permanent move of at least one year, that involves crossing a geopolitical but not necessarily a national border. As a result, migrants alter their baseline population of reference and their local networks (Brown & Bean, 2005). Researchers use characteristics such as crossing administrative boundaries, distance travelled, duration of stay or motivation for migration to describe and categorize migration. Immigration and emigration describe permanent migrations across international boundaries. However, movements of people occur on all temporal and geographical scales and can be associated with less permanent processes, such transhumance, seasonal migration or weekly commuting. These processes tend to be associated with mobility, a lifestyle characterized by many locations and many moves between them, not migration from one stable state to another.

Migration is most reliably predicted by age since most populations showing the same mobility profile; young adults are the most mobile since multiple lifecycle changes are concentrated in a short period of time: leaving school, finding employment, marriage and starting a family (White and Lindstrom 2005). In recent decades, migration theorists have placed less emphasis on finding a unifying theory of migration (Piguet 2009), and instead acknowledge the context specific nature of models (Massey, Arango et al. 1993).

In this section, I describe three different approaches to understanding migration: neo-classical economic theories; behavourial theories; and the New Economics of Labour Migration. All these theories give the migrant agency over their actions and focus on the individual migration decision-making process.

The theories, their key characteristics and how they inter-relate are illustrated in Figure 2.1. Neo-classical economic theories at the level of the individual were an effort to explain why the geographic equalization of wages, predicted by these theories, is never actually observed. The New Economics of Labour Migration emerged as a reaction to some of the assumptions made in neo-classical economics: such as a lack of acknolwedgement of the role of human agency in migration, the potential migrant is assumed to act in isolation from others around him or her, economic rationality lacking any emotional input and that migration occurs at the exclusion of other livelihood strategies. Behavourial migration theories, developed from psycholocial decision-making models are also extended economic rationality models in the sense that a person trades off the utility they gain from their current location against that which they expect/imagine in an alternative location. However, utility is created by a much broader set of factors, and the interaction of the potential migrant with their environment is taken into account.

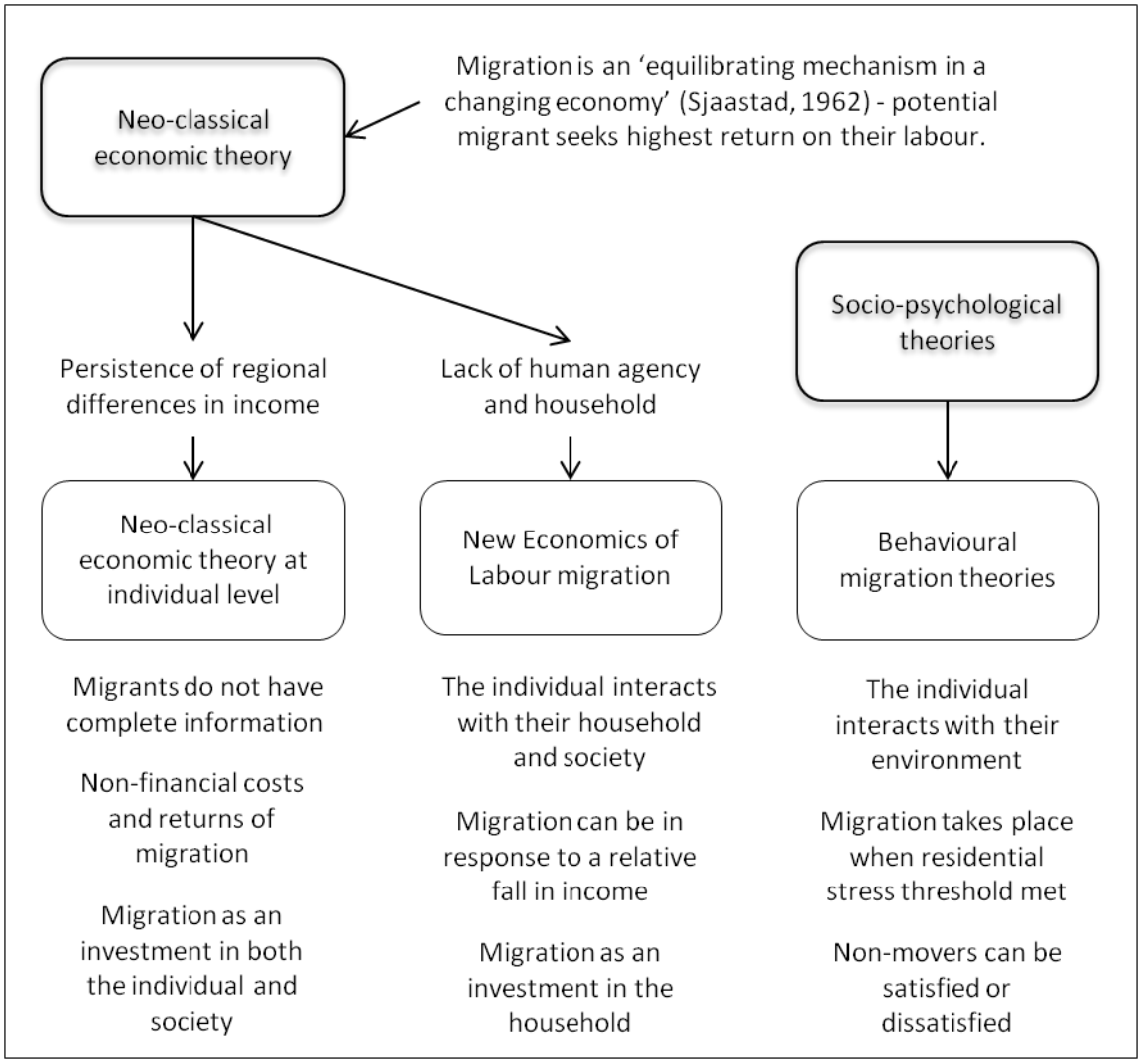

Figure 2.1: Three theories of migration at the level of the individual, their distinguishing characteristics and their theoretical roots. This review addresses neo-classical economic theories, behavourial theories and the New Economics of Labour Migration. Extended economic rationality forms the basis for all theories: the potential migrant weighs up the costs and benefits of migrating versus remaining in location.

At a macro-level neoclassical economic theories use differential rates of economic development, which leads to different returns on labour for the individual, to explain migration: migration is the result of spatial differences in the supply and demand of labour in the context of economic development (Lewis 1982). These theories predict a flow of people to take up jobs in regions with higher income levels. This is predicted in turn to cause a decrease wage differentials and a cessation of migration. However, geographic equality in wages is rarely observed (Sjaastad 1962) and regression modelling reveals migration to be a result of differences in the size and structure of the population in the sending area rather than to differences in employment opportunities (Lewis 1982).

Harris and Todaro (1970) attempt to explain the lack of equalization of wages by taking into account the role of incomplete information in encouraging migration. Harris and Todaro (1970) suggest that people move not because of absolute higher wages in the receiving area, but because of *expected* higher wages and that people take certain risks in terms of gaining

employment when they migrate. Sjaastad (1962) describes migration as a way of improving resources allocation, as opposed to a way of equalising earnings spatially, and looks at the costs and returns of migration to the individual. Costs of migration include monetary costs, opportunity costs and the emotional costs of leaving family and home. The returns of migration include possible occupational upgrading and an investment in the human agent – the latter a factor that Sjaastad sees as key in the migration process. In this way, theories begin to take into account the costs and returns of migration beyond income and recognise the role of human aspiration in driving migration.

Despite this wider conceptualization of the costs and benefits of migration, these theories do not take into account that migration is used as a way of staying in a specific location, as part of a wider livelihood strategy, and that a household may pool their resources and risks. The cost-benefit analysis often occurs at a level beyond that of the individual. Furthermore, although they introduce the psychic costs of migration, emotions and feelings of the potential migrant are not explicitly included. The New Economics of Labour Migration (NELM) address these shortcomings.

One of the key aspects of NELM theories is that migration occurs as 'a response to feelings and an exercise of independent wills' (Stark and Bloom 1985; 173). This means that it is not necessary for a person's actual income to fall for their utility to decrease and migration to be considered. In reality, it may only require a person to become more deprived in relation to other people in their reference group that have become better off. As a result, a region with more income inequality is more likely to produce out-migration because there will be more relative deprivation (Stark and Bloom 1985) and therefore wage differentials between the sending and receiving location are not a prerequisit for migration (Massey, Arango et al. 1993).

This theory also recognizes the household as the decision-making unit and that the migrant is not always the person who has made the decision to migrate (Stark and Bloom 1985). Migration is also acknowledged as one of many strategies used to diversify livelihoods and spread risk (Ellis 1988). The migrant can be sent by his or household into 'a sector where earnings are either negatively correlated, statistically independent, or not highly positively correlated with earnings in the origin sector' (Stark and Bloom 1985; 175). Remittances are used to insure against risk in economies of the home country where formal institutions such as futures markets and social support are not available. They take the role of insurance against crop failure, crop price fluctuations and unemployment and disability. Remittances also provide households with the capital they require to invest in the absence of reliable saving and borrowing institutions (Massey, Arango et al. 1993).

In this way, the migrant is not seen as splitting him or herself apart from the family unit, but instead entering into an 'intertemporal contractual arrangement' (Stark and Bloom 1985; 174)

with their family where both the costs and returns of migration are shared. Migration is viewed as "a 'calculated strategy' and not as an act of desperation or boundless optimism" (Stark and Bloom 1985; 175).

In the new economics of labour migration, international migration, local migration and local employment are taken in the context of livelihood diversification and are not mutually exclusive options (Massey, Arango et al. 1993). Economic development in sending areas may lead to increased migration as people engage in migration to counteract the risks of the capital investments involved in that economic development. Furthemore, "the same expected gain in income will not have the same effect on the probability of migration for households located at different points in the income distribution, or among those located in communities with different income distributions" (Massey, Arango et al. 1993; 440).

NELM theories of migration incorporate the role that previous migrants play in perpetuating migration as a process through migrant networks. As more people migrate it becomes easier for those that remain to migrate. The information provided by migrants to the stayer population can lead to 'an upward revision of beliefs that migration is a worthy investment' (Stark and Bloom 1985; 176). Furthermore, the migrants in the destination help the new migrants as they arrive, and themselves benefit from this interaction.

The ideas of NELM have defined development strategies and shaped the relationship between mobility migration and development. Encouraging mobility as a development strategy has both its supporters and its oponents with some authors advocating the need for the advantages of mobility and migration to be recognized in development, while others criticize advocates of mobility for perpetuating the neo-liberal economic model of development (Bakewell 2008; Felli and Castree 2012). The role of international remittances in development continues to be an important area of research especially as the value of remittances in some countries is more than development aid (Cohen 2011). This group of theories recognizes the cultural links between the migrant and their home village and which can perpetuate and sometimes explain migration flows (Cohen 2011).

In behaviourial migration theories, it is less the influence of the household that comes to the fore in influencing the migration decision-making process, and more the characteristics of the environment or situation which provide satisfaction or stress to the household as a whole. Some aspects are very simliar to the approaches of Harris and Todaro and Sjaastad in nuancing the economically rational human decision-maker further, embracing the idea that people do not make the decision to migrate on perfect information, nor rationally (Lee 1966; Brown and Moore 1970). However, in this set of theories a person decides to migrate not to access better returns on their labour/human capital but when a household threshold for residential stress is reached.

Behavioural theories focus on migration decision-making as a process: stress is experienced, place utility moves from positive to negative and the decision-making process is initiated (Brown and Moore 1970; Speare 1974). The level of stress or dissatisfaction tolerated is inversely related to mobility potential (Lonergan 1998) and so mobility and place utility trade-off against each other in creating the level of stress which a person is willing to tolerate. Once that threshold is crossed migration does not necessarily take place because intervening obstacles are too great (Lee 1966) or due to a negative outcome of the cost benefit analysis of the expected utility gained in alternative locations (Quigley and Weinberg 1977). Migration is not the only way to reduce household dissatisfaction (Quigley and Weinberg 1977). Figure 2.2, adapted from Jones (1990), shows the various stages of the decision-making process.

Place utility is an indication of how much a person likes the place in which they live, 'a positive or negative quantity, expressing respectively the individual's satisfaction or dissatisfaction with respect to that place (Wolpert 1965; 162). Mobility potential relates to how easy it is for people to move; some people are 'easily movable' while others are 'virtually immobile' (Morrison 1972). People with high mobility thresholds are responsive to opportunities elsewhere; those with low mobility potential are not aware of such opportunities, or do not take them up even when they are aware of them. Search and evaluation is constrained by the *awareness space* of a household composed of an *activity space* (information available to a person through contacts in their daily life) and *contact space* (secondary information sources such as newspapers) (Quigley and Weinberg 1977).

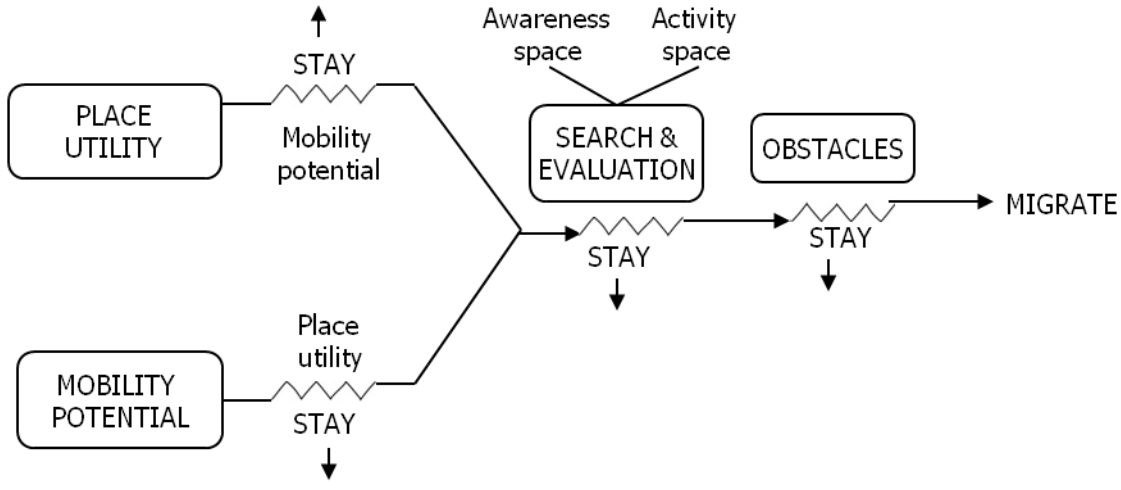

Figure 2.2: The migration decision-making process from a behavioural perspective. If place utility is high enough to counteract high mobility or mobility is too low to respond to low place utility a person raises their stress threshold and leaves the migration decision-making process. The absence of a suitable alternative location can lead to a positive reassessment of a current residence. Alternatively, financial, physical and psychological costs of relocation may require people to raise their stress thresholds and stay in place.

Dissatisfaction "is the direct result of changes in the needs of a household, changes in the social and physical amenities offered by a particular location, or a change in the standards used to evaluate these factors" (Speare 1974; 175). External factors can impact negatively on the functioning of that household, and will result in a state of stress (Brown and Moore 1970; 2). However, not all environmental impacts will be stressors to every household, and each household will feel stress to a different degree (Lee 1966). Not everyone has carried out the cost benefit analysis with regard to the place utility of their current versus potential alternative locations. There are also people who are satisfied and have not considered moving (Speare 1974).

Behavioural migration theories are useful in understanding how the environment might affect migration since they recognize that different external changes will not affect all households equally. Furthermore, if the natural environment contributes to a person's residential satisfaction, it provides a way of allowing changes in the natural environment to interact with the migration decision-making process. Finally, explicit in these theories is the idea that migration is not the only way to alleviate residential stress and that residential stress sometimes has to be tolerated or the household restructured in situ (Quigley and Weinberg 1977), making them useful for understanding whether and why migration is used as an adaption or represents a failure to adapt.

There are aspects of behavioural theories that make testing them problematic. The theories are weak on conceptualizing the household and intra-household decision-making processes on migration. They do not take into account other temporal or geographical scales of migration other than a permanent move of the entire household since they address intra-urban residential choice. Most problematic for their implementation are the psychological aspects. Measuring mobility potential is difficult and internal stress thresholds almost impossible to define. Therefore, it would be very difficult to say exactly at what point a household may make the decision to move. Finally, the trade-offs made for choosing a new residence within a city keeping employment the same requires a different set of trade-offs to be made and risks to be taken than migration between different settlements to access employment or opportunities. Can theory originally used for intra-urban mobility be applied to understanding rural-urban migration?

Despite these limitations, behavioural models are most appropriate for use in a study of the influence of environment on the migration decision-making process. They explicitly acknowledge the interaction of a person and their environment (defined in its broadest sense) in creating utility. Secondly, the use of theories based around a stress-threshold avoids reducing migration to push and pull factors, and the need to isolate the influence of specific push factors.

In the following sections, look at the ways in which people gain satisfaction from location in rural area. It expands the idea of place utility beyond intra-urban mobility decisions and uses the concept of ecosystem services to incorporate the environment into place utility.

2.3 Place utility: the role of place in migration decision-making

This section investigates the ways in which people gain utility from place in a rural setting. Place utility is an indication of how much a person likes the place in which they live (Wolpert 1965; 162). Dissatisfaction is generated by a change in needs, a change in the services offered by location or a change in the way people view their enviornment (Speare 1974; 175). The way in which a person perceives services in a location is as important as the existence and use of those services.

This chapter, in order to understand better the way people gain utility from where they live looks at three different bodies of work: sense of place, rurality and ecosystem services. Sense of place focuses on affective attachment to place, rurality on the diverse nature of rural livelihoods and ecosystem services on the utility gained specifically from the natural environment.

2.3.1 Sense of place

Place can be defined as a 'meaningful location' (Lewicka 2010). Place has both a material form and a cultural interpretation (Gieryn 2000) and the material form gains meaning through 'accumulated biographical experiences' and 'interactive and culturally shared process' (Gieryn 2000; 481). However, the physical environment doesn't just hold socially created significance, but is not significant in its own right: 'residents of neighborhoods near prominent landmarks, or with easily defined edges, or with better quality housing stock, are more likely to have stronger emotional bonds to where they live' (Gieryn 2000; 481).

Sense of place is the overarching term for more specific ways in which people attach meaning to the location in which they live. Place attachment refers to the affective bonds that a person has with their location; place dependence describes instrumental bonds formed through the ability of a place to help a person meet goals and aspirations (Quinn, Lorenzoni et al. 2012 in prep.). Place attachment at its most extreme takes the form of 'rootedness' which is "made possible by an incuriosity toward the world at large and an insensitivity toward the flow of time" (Tuan (1930; 4) in Fresque-Baxter and Armitage 2012).

Previous quantitative studies on sense of place have used single and multi-dimensional measures to understand attachment to place and the non-material utility gained from a place (Lewicka 2010). Of the socio-demographic variables that have been studied (residence length, age, social status and education, home ownership, size of community, presence of children, mobility and range of mobility), residence length emerges by far the strongest predictor of place attachment. For immigrants, the sense of attachment increases most rapidly in the first few years in a new place (Lewicka 2010). Views are divergent on whether a newcomer to a place can ever develop the same place attachment as person that was born and raised there; some describe increasing

levels of 'insideness' with time spent in a location (Relph 1976). Others do not find that place attachment is always directly related to time in that location (Kaltenborn and Williams 2002).

While there is evidence that mobility can increase attachment to a place when people become fonder of their location after time spent away, in general, mobility affects sense of place through its interaction with time of residence in location, which is a much stronger predictor of sense of place (Lewicka 2010). Social predictors of place attachment are mostly community ties (i.e. local social capital). This is a consistent positive predictor of place attachment with social security having a similar effect.

People form attachment to the physical environment in which they live. Neighbourhood attachment has been found to be affected by 'quiet areas, presence of aesthetically pleasant buildings, presence of green areas and lack of perceived incivilities' (Lewicka 2010; 39). In another study 'access to nature, housing and neighbourhood quality, sense of safety, home ownership, municipal services, sense of neighbourhood and community and household density', predicted residential satisfaction better than the social factors with access to nature the strongest. Another study identified 'perceived control over the residence area, the stability of the neighbourhood, and a lack of pollution and disorder'. The relative importance of physical factors can be dependent on socio-economic status, age factors or place scale.

Sense of place has the potential to explain why some people endure higher levels of residential stress than others, why some people feel stress under certain external events while others do not and why migration does, and more importantly, does not occur in people and households with similar mobility characteristics. With respect to environmental change, the role that the natural environment plays in creating place attachment is recognized in the literature especially in terms of recreational areas such as national parks (e.g. Williams and Stewart 1998; Kaltenborn and Williams 2002).

The following section investigates attachment to the natural environment in the context of ecosystem services framework. The ecosystem services framework provides a way of assessing the material, non-material and cultural benefits that humans gain from the natural environment. An ecosystem service is defined as "the goods and services provided by ecosystem functions from which human populations derive benefit (Costanza, d'Arge et al. 1997; 253). They are 'the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life' (Kibert 1997; 3).

2.3.2 Ecosystem services as the link between human wellbeing and the environment

Ecosystem services are "the aspects of ecosystems utilized (actively or passively) to produce human wellbeing" (Fisher et al, 2009; 645). In this way both ecosystem structures and processes, and the products that arise from them are included. Ecosystem services can be both directly and

indirectly used or consumed and they are not considered a service, unless there is a human beneficiary (Fisher et al, 2009; 645). Ecosystem structure and processes (intermediate services) give rise to final services, which through the input of other forms of capital (e.g. dams to harvest drinking water), provides benefits that increase human wellbeing. This definition is most useful for those services which equate to natural resource provision and aid in the management of such resources.

Wellbeing is defined in the Millennium Ecosystem Assessment as having "basic material for a good life, freedom and choice, health, good social relations, and security" but at the same time being "context- and situation-dependent, reflecting local social and personal factors such as geography, ecology, age, gender, and culture" (Millenium Ecosystem Assessment 2005; 71). Therefore, ecosystems and the benefits that they provide are inherently place specific.

The ecosystem services framework groups the benefits obtained by ecosystem and their processes into four groups: supporting, regulatory, provisioning and cultural (Millenium Ecosystem Assessment 2005). This typology of ecosystem services is outlined in Table 2.1. Although a useful starting point, this categorization should be placed in the context of the characteristics of the ecosystem services in question, the decision-making context, processes versus outcomes, and the differential use of and access to ecosystem services (Fisher et al. 2009; Daw et al. 2010).

The Millennium Ecosystem Assessment (MEA) moved discussions beyond natural resource use to a more nuanced definition of the services that humans gain directly and indirectly from the ecosystem services around them (Daniel et al, 2012). The MEA recognized that ecosystem services are interrelated and that there are trade-offs between them, something that has been elaborated on since (Rodriguez et al, 2006; Bennett et al, 2009). However, the MEA categorizations, while having driven the conceptualisation of ecosystem services since 2005, fall short in analysing and conceptualising ecosystem services, confusing services from goods, and stocks and flows from structures and processes (cf. Fisher et al, 2009).

Supporting	Provisioning	Regulating	Cultural
Services necessary for the production of all other ecosystem services	Products obtained from ecosystems	Benefits obtained from regulation of ecosystem processes	Nonmaterial benefits obtained from ecosystems
• Soil formation • Nutrient cycling • Primary production	• Food • Fresh water • Fuel wood • Fibre • Biochemicals • Genetic resources • Ornamental resources	• Air quality maintenance • Climate regulation • Disease regulation • Water regulation • Water purification • Erosion control • Pollination • Storm protection	• Cultural diversity • Spiritual and religious values • Knowledge systems • Educational values • Inspiration • Aesthetic values • Social relations • Sense of place • Cultural heritage • Recreation/ecotourism

Table 2.1: Categorization of the services provided by ecosystems as presented in the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment 2005). The assessment conceptualizes the benefits provided by ecosystems as supporting, provisioning, regulating or cultural.

Which ecosystem processes are considered services, and the relative value of those services is highly subjective, even with respect to provisioning services. Ecosystem services can be valued in many different ways, and different valuation methods, even in the same system, will lead to the prioritization of different services (Barbier, 2007). The ecosystem services that are valued vary with the spatial scale (Hein et al, 2006) and the stakeholder group (Daniel et al, 2012) in question. The value of cultural ecosystem services is even more subjective and local, with boundaries even more difficult to identify (Daniel et al, 2012). Furthermore, there are equity issues with respect to valuing services in order to make payments for their preservation (Corbera et al, 2007).

The ecosystem services framework has been criticized for its anthropocentric approach and the commoditization of nature which comes from only providing ecosystems with a value if they provide benefit for humans (McCauley 2006; Wallace 2007; Kosoy and Corbera 2010). Since the cultural services of nature are some of the hardest to quantify and value, they are often poorly incorporated into analyses of ecosystem services (Rodríguez, Beard et al. 2006).

Cultural ecosystem services are described as the 'meaningful interactions between people and nature' (Church et al, 2011; 679) or alternatively as "ecosystems' contributions to the non-material benefits (e.g., capabilities and experiences) that arise from human-ecosystem relationships" (Chan et al, 2012; 9). While their identification is often no more subjective than for provisioning services (different cultures value different provisioning services differently and meet their basic needs in different ways) they have been little incorporated in analyses to date since their attributes do not lend themselves to economic valuation. This is because they often are provided by shared, common property goods, such as landscapes, sacred grounds and green spaces (Daniel et al, 2012).

Culture is often poorly and naively characterized to fit into economic or biophysical frames of reference (Chan et al, 2012; Satterfield et al, 2013). Recent research on cultural services presents two different methods for incorporation. One way relies on methods from other areas of environmental social science (Daniel et al, 2012). Cultural ecosystem services are implicit in the analysis of landscape aesthetics, cultural heritage, and recreation and tourism and spiritual and religious significance. The uniqueness of a landscape lends people to assigning a symbolic value to the landscape (Kirchhoff, 2012). However, the ability to incorporate such cultural values, formed by attaching symbolic meanings to landscapes, into the framework of the Millennium Ecosystem Assessment is questioned (Kirchhoff, 2012). Another approach is that taken by the National Ecosystem Assessment. Here, the ways in which various forms of socio-ecological systems satisfy various types of human needs to different degrees according to Max-Neef's (1992) classification is investigated. Interaction occurs at various scales, from domestic gardens to local green spaces, and nearby and national countryside. The way in which a person's needs are met changes throughout. Chan et al (2012) identify eight dimensions of values that are important for environmental decisionmaking and the better incorporation of cultural services: preferences versus principles versus virtues; market mediated versus non-market mediated; self-oriented versus other oriented; individual versus holistic/group; experiential versus metaphysical; supporting versus final (instrumental versus inherent); transformative and non-transformative; anthropocentric versus biocentric.

Humans depend on both ecosystems where human influence occurs early in the chain of benefits such as oceans and forests, and ecosystems where a capital input is used to increase their productivity and the benefits obtained (such as agriculture and aquaculture). Agriculture, the mechanism usually used to link the environment with human wellbeing, is a managed ecosystem both depending on ecosystem services (e.g. water and pollination among others) and providing ecosystem services (e.g. food and fibre products) (Swinton, Lupi et al. 2007; 246). Mobility to access different suites of ecosystem services is a commonly observed practice, exemplified in transhumance. In mountain regions, mobility is used to take advantage of rapid changes in ecosystems and their services over short distances due to changes in altitude and associated changes in climate.

Provisioning services tend to be valued more highly than regulating and cultural services (Rodríguez, Beard et al. 2006). This order of preference follows the ecosystems which a settlement will prioritize as it colonizes a pristine area, and relates to different levels of needs, the most basic being food and shelter, then the ability to live in a clean, secure environment followed by higher level needs (Rodríguez, Beard et al. 2006). Whether this works on the individual level, and a person who is less materially well-off values provisioning services more highly than cultural services, is not clear. The importance of cash transactions of, and employment from, ecosystem

services is not addressed in the MEA (Tim Daw et al, 2011). Ecosystem services provide wages through the role that the provision of water plays in extractive industries and mineral water bottling. Most of the produce of farming systems, both the result of consumption of ecosystem services and a provisioning service, is not for subsistence but for sale. Furthermore, there are shopkeepers that benefit from the income that farming generates for others in the village.

This highlights the need to consider inequalities in access to natural resources (Ribot and Peluso 2003) and the different way that different social groups benefit to lesser or greater degrees or in different ways from the same ecosystem services (Daw, Brown et al. 2010). Degradation in ecosystem services will not affect a group that does not have access to them (Turner, Cakacaka et al. 2007; Daw, Brown et al. 2010). Although less access to ecosystem services can be associated with less security (Daw, Brown et al. 2010), in general the poor are more affected by ecosystem service change because of a greater reliance on natural resources for income and because any change in an ecosystem will be relatively greater for a person with less income (Daw, Brown et al. 2010).

Therefore, this section has investigated place utility from two further perspectives – identity and aspects and the ecosystem services aspects. Combining these two ways of approaching place utility, places emphasis on the non-material benefits gained from the natural environment. Social systems are linked to the natural environment in which they are situated through 'the dependence on ecosystems of communities and their economic activities' (Adger 2000; 347) and these connections are assumed to be or tend to be stronger in rural settings. The settlement itself is a major part of understanding migration because it is part of place utility and the site of and manifestation of ecosystem services.

2.3.3 Rurality

The degree to which the population of a settlement interacts with, and gains utility from, ecosystem services vary and that in rural migrations there is a large mix in the degree of rurality. In places geographically remote from major cities, no longer completely culturally or institutionally rural, the relationship between the population and the environment in which they live has altered.

Urban versus rural is often defined by population density. However, places can be as densely populated as urban areas but with rural characteristics and institutions (Qadeer 2004). Extreme rurality has been defined by remoteness and peripherality (Cloke and Edwards 1986). However, in populous countries rurality relates more to institutions and remoteness from services rather than physical removal of a population from others.

Rural locations are diverse in the degree to which their populations depend on ecosystem services for their income; rural livelihoods are not necessarily agrarian (Machlis, Force et al. 1990;

Bebbington 1999). However, primary industries from the basis of income generation in rural locations. Extractive industries play a key role in the generation of income in rural locations since mineral reserves are randomly located with respect to the socio-economic powerhouses of a country (Freudenburg 1992).

Both extractive industries and migration to access labour are a means of keeping the household in the rural area but can have negative implications for the rural location. Extractive industries bring incomes and the development of infrastructure and services but not an increase in capabilities (Freudenburg 1992). Resource dependency can be dependency on one ecological system (e.g. coastal systems) not just on one cash crop (e.g. timber) or minerals (Adger 2000; Winkels 2008).

Migration has always played a role in allowing rural lifestyles to persist (Bebbington 1999). Emigration of economically active males can put unnecessary burden on women and elderly in terms of managing the household and land (Winkels 2008). However, physical and cultural links of emigrants to urban areas are maintained with their home villages through land tenure and other social and cultural mechanisms (e.g. village festivals, voting, censuses). This in turn has allowed the persistence of their rural culture: "people have built economically viable livelihood strategies that, while neither agricultural nor necessarily rural, allow people to sustain a link with rural places, and in turn allow the continued reproduction of these places as distinctively Quichua" (Bebbington 2000: 495).

Although the rural setting is where ecosystem services are likely to be most prominent in terms of creating utility for the population, a rural location is not necessarily agrarian. Rural areas are diverse in the nature of their dependence on ecosystem services; the strategies used to maintain the population while geographically isolated from economic centres; and their cultural and physical links to urban areas. All these factors will affect the degree to which environmental change, and a related degradation in ecosystem services, will lead to a response in the population, and whether that response will be migration.

The cultural and emotional significance of place, as addressed in this research through the ideas of sense of place and incorporated into migration theory through the concept of place utility, has been absent in theories of migration and theories of climate change migration. This is in spite of the fact that discussions on the limits to adaptation to climate change and benefits gained from ecosystems already consider such values.

2.4 Migration as an adaptation to environmental change

This section focuses on efforts to understand the conditions under which migration is the preferred response to environmental change (McLeman and Hunter 2010). Rates of migration have been found to both increase and decrease with environmental degradation and migration

can be both the adaptation of choice and the adaptation of last resort when all other avenues have failed (McLeman and Smit 2006).

Migration can be associated with high vulnerability, with an unstable regime and a breakdown of social resilience (Adger 2000). However, it is also a strategy to decrease risk and increase assets, an integral part of a household livelihood strategy (Ellis 1988).Vulnerability to climate impacts interacts with mobility and the ability of people to leave risky or stressful areas (Black, Kniveton et al. 2008; McLeman, Mayo et al. 2008). Aspects such as gender also play a role in the decision to migrate with respect to environmental change (Gray 2010).

Migration is the result of causal processes that operate over many spatial and temporal ranges (Suhrke 1994; McLeman and Hunter 2010). The environmental changes that impact on migration may be slow onset environmental degradation, extreme events that create displacement such as cyclones or hurricanes, or repeated lower-scale extreme events such as flooding. Dun (2011) found that repeated flooding evens in the Mekong Delta in particular socio-economic contexts had the potential to lead to a range of migration outcomes from seasonal migration to permanent outmigration. Changes in climate have been associated with settlement abandonment (Arenstam Gibbens and Nicholls 2006; McLeman 2011). Short-term, short-distance migration has been observed in response to damage to and loss of property (Elliott and Pais 2006; Falk, Hunt et al. 2006; Landry, Bin et al. 2007); long term, short-distance in response to inundation and loss of land (Haque 1989). Migration induced by longer term changes in precipitation resulting in diminishing returns on agricultural and failed harvests (Eakin 2005; Feng, Krueger et al. 2010) can be across international boundaries to access labour markets, where such flows already exist.

Studies have tended to focus on three kinds of environmental change as proxies for impact of future climate change: desertification, drought and land degradation, extreme weather events and sea level rise (Tacoli 2009). Environmental change has primarily been factored into analyses through either a focus on resource scarcity as a factor influencing relative economic opportunities in source and destination areas (Feng, Krueger et al. 2010) or as a set of hazards that drive displacement of populations or as vulnerabilities to be overcome to avoid involuntary migration (e.g. Afifi and Jager 2010).

Hurricanes, tsunamis and other extreme events necessitate short-term displacement of the population. However, there is little evidence to suggest that this displacement persists as disaster-induced migration (Paul 2005; Tacoli 2009) after extreme events and sometimes extreme events can act as a population pull due to reconstruction work and government aid (Piguet, Pécoud et al. 2011).

Whether environmental degradation does increase rates of migration depends upon the socio-economic and geographical setting and the kind of environmental resource affected. A climate

driven reduction in crop yields was related to increased emigration from Mexico to the United States (Feng, Krueger et al. 2010). In the setting of the Ecuadorian Andes, land resources facilitate international migration in men and degradation reduces the likelihood of woman migrating (Gray 2010). In another mountainous setting in Nepal, long distance moves are influenced by declines in productivity of crops, however, a stronger effect is detected on short distance moves from perceived declines in productivity and land cover and increased time required to gather firewood (Massey, Axinn et al. 2007). Access to forest resources increases security of the population of the rainforests of Cameroon, thereby reducing migration from the area (Ruitenbeek 1996).

A recent systematic review of the links between environmental change and migration (The Government Office for Science 2011) supported the fact that environmental change can impede as well as increase migration and advocated thinking strategically about helping low mobility groups. The most immobile have no choice but to stay in location in spite of worsening environmental conditions (Adams 2008) since they do not have the resources to overcome barriers to migration, nor the human capital to find work in other locations. The next section looks at the frameworks that the research community have proposed to systematically analyse the ways in which environmental change interacts with social processes to encourage or impede migration. On finding these frameworks lacking, I present a new analytical framework, based in the ideas of behavioural migration theory and ecosystem services.

2.5 Analytical framework using ecosystem services to link environmental change and migration decision-making

As highlighted in the previous sections, there is a long history of creating theoretical models of migration. This section addresses the frameworks that exist which conceptualise the relationship between the environment, environmental change and migration.

Mabogunje (1970) was one of the first authors to look systematically at rural-urban migration by applying a systems approach. Wisner et al.'s pressure and release model (2004) looked explicitly at how environmental hazards interact with societal processes to become natural disasters, but did not specifically address migration as a response to natural disasters. More recently there have been attempts to provide analytical frameworks to understand how environmental hazards in particular interact with migration (McLemen and Smit 2006; Perch-Nielsen, Bättig et al. 2008; The Government Office for Science 2011). Table 2.2 provides a summary of four such models, which are useful in furthering our understanding of the links between environmental change and migration, but like earlier migration theories, address different scales and different environmental impacts and so are not easily generalisable.

Geographic region/Impact	Key features of the framework	Disadvantages	Author(s)
Low-income countries/ Land degradation	• Impact of population growth on migration through environmental degradation • Certain forms of migration perpetuate environmental degradation	Only addresses human-driven environmental degradation	Bilsborrow, 1992
United States/ Drought	• Based in the concepts of vulnerability • Incorporates household adaptation • Incorporates capital endowments as an intervening factor • Acknowledges return migration and immigration into community	Does not incorporate differential exposure to risk	McLemen and Smit, 2006
Global/ Flooding and sea level rise	• Makes explicit the ways in which climate impacts affects humans • Incorporates both direct and indirect effects of environmental changes • Incorporates adaptation to modify vulnerability	Strength of impacts and linkages not addressed	Perch-Nielsen et al., 2008
Global/ Environmental change	• Drivers based in different forms of capital • Environment considered a driver of migration itself susceptible to environmental change • Both structural and behavioural influences on migration	Migration decision-making reduced to a 'black box'	Foresight, 2011

Table 2.2: Selected frameworks for the analysis of the interaction of environmental change and migration. Each framework addresses a different environmental impact and stems from a different theoretical basis.

Bilsborrow's (1992) model emerges from an earlier field of work which focused on population pressures on the natural environment and the role of immigration to frontier areas in driving environmental degradation. McLemen and Smit's (2006) model speaks to the climate change adaptation school of thought, focusing on impacts, vulnerability and the ability of people to adapt. Perch-Nielsen et al. (2008) also belong in this school of thought, since their approach is top-down impacts driven and stresses the role of adaptation in mediating between environmental impacts and the environment.

Due to these disciplinary roots, the models have not incorporated nor acknowledged extant migration theory and models. Past migration processes and variations in current mobility potential that will influence migration under environmental change are not included, bar McLemen and Smit (2006) who include immigrants and return migrants in their model. However, in general, the treatment of the mobility characteristics of the sending area have been simplistic, assuming a homogenous sending area population and a migration or no-migration response. A treatment of affective and identity components of the migration decision-making process is absent. This is in spite of a large body of literature on not only on their importance in driving

human behaviour in general but the cultural significance of the environment in many cultures (e.g. Rhoades, Rìos et al. 2008; Adger, Dessai et al. 2009).

Figure 2.3 presents a new framework for analysing the potential impact of environmental change on migration and its constituent elements, addressing the gaps highlighted in the previous section. In particular, the framework acknowledges the fact that the decision to migrate lies fundamentally with the individual and depends on his or her preferences and agency (White and Lindstrom 2005; Kollmair and Banerjee 2011) and so starts by understanding migration at this level. The most any model of migration can do is identify the most likely responses of common groups (Lee 1966). This model identifies groups that are likely to show a similar response to environmental change based on their mobility characteristics, levels of satisfaction with place, barriers to migration, contribution of ecosystem services to their wellbeing and characteristics of their settlement.

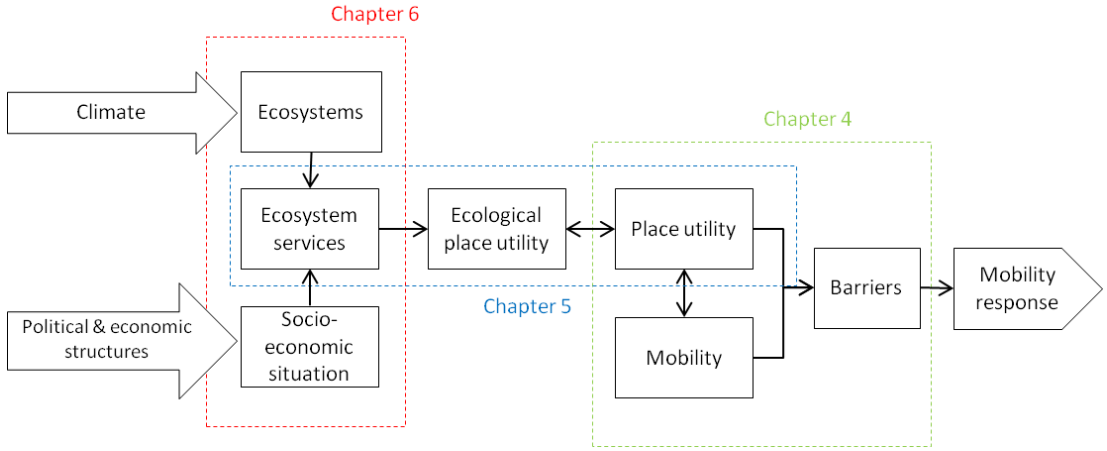

Figure 2.3: Analytical framework linking environmental change with migration using ecosystem services. The degree to which a change in ecosystem services affects the migration decision process depends on the proportion of wellbeing gained from those services, this itself a function of the settlement in which the potential migrant lives. Whether or not a fall in wellbeing translates to a migration outcome depends on the initial place utility of the person (positive or negative) and their mobility potential, conceptualized as both an ability to overcome resource barriers to migration, and an intrinsic, psychological willingness to migrate.

The model uses ecosystem services as the critical analytical link between environmental change and migration through the contribution that they make to human wellbeing. Climate change acts upon ecosystems and the level and quality of the services that they provide to society. Information is collected to create profiles of mobility and satisfaction with place and the sensitivity of that satisfaction to climate and environmental factors. The model predicts environmental migration by a person's susceptibility to an event, not the strength or type of event.

If vulnerability is a function of exposure, and adaptive capacity and exposure is measured through the degree to which a person relies on ecosystem services both for their residential satisfaction, adaptive capacity here is conceptualized as the degree to which a person is able to respond to a

fall in their place utility with a migration response. The idea is that those individuals or groups that have mobile characteristics will adapt by migration while the less mobile groups will chose, or be forced, to adapt in situ.

Place utility is used to interpret how a fall in wellbeing related to a decrease in the quality of ecosystem services will translate (or not) into a migration output. A person can have a positive or negative satisfaction with place. The fall in utility from ecosystem services interacts with this initial level of dissatisfaction to bring a person closer to their stress threshold and the act of migration. The level of the threshold, and whether someone is able to act upon their dissatisfaction, depends on their mobility.

The degree to which a degradation of ecosystem services impacts upon a person depends upon the how much ecosystem services contribute to their wellbeing. In this framework, this level of ecological wellbeing is assessed by the degree to which a person depends on ecosystem services for their income (regulating and provisioning services) and the degree to which their attachment to place is includes ecological aspects (in general cultural and regulating ecosystem services).

The characteristics mentioned in the previous two paragraphs are influenced by the socio-ecological interactions that have developed in the actual location. A settlement develops in a particular way because of the range of ecosystem services available and the interaction of socio-economic factors with ecosystem services. The system is vulnerable to changes in the climate, as well as political and economic change. These influences and interactions lead to the emergence of different migration systems. The term socio-ecological system is used to specifically acknowledge that humans, their management practices, property rights, knowledge systems and world views (that is to say, the social system) cannot be separated from the natural environment in which it exists. The social system and ecological system are inextricably linked and something cannot be changed in one system without impacts on the other (Berkes and Folke, 1998).

The framework described above generates a set of research questions. Although each sub-section of the framework provides value in isolation, contributing to understanding of migration decision-making, affective attachment to place and migration systems in rural settings, when combined they provide a model of migration decision-making under environmental change. This model provides quantitative projections of the type and frequency of responses that a particular population may exhibit in response to a degradation of the ecosystem services identified as contributing to place utility.

2.6 Research questions

The framework outlined in Figure 2.3 moves beyond existing frameworks by using ecosystem services to systematically unite changes in the environment with migration decision-making through the common concept of wellbeing or satisfaction. To test the efficacy of the constituent parts (highlighted in Figure 2.3 with dashed boxes) I develop a set of hypotheses that are tested in the following analysis.

The first set of hypotheses relates to the interaction between mobility potential and place utility intimated by behavioural migration theory:

1. Populations contain members with both positive and negative place utility and initiating the migration decision-making process represents a shift from positive to negative place utility;
2. High mobility potential and negative place utility individuals are likely to be emigrants in any population and therefore absent or at low numbers in traditional sending areas. If such individuals are present they will be subject to resource barriers to migration;
3. High place utility is a function, in part of the population, of low mobility potential.

The second set of hypotheses relates to the contribution of ecosystem services to place utility and the relative roles of instrumental versus affective bonds to ecosystem services. This chapter proceeds on the assumption that something other than income is providing utility in satisfied population in a marginal, rural sending area:

1. Utility in rural populations is gained not just from provisioning but from regulating and cultural ecosystem services as well;
2. Utility gained from ecosystem services varies among the population;
3. The type of utility gained from ecosystem services varies between sub-groups of the population.

The third set of hypotheses addresses the role of place-specific factors in the decision to migrate and the importance of ecosystem services in shaping the development of a settlement, which influences the migration and socio-economic systems that develop:

1. Rural settlements are not uniform in the degree to which they gain satisfaction from ecosystem services;
2. Different socio-ecological systems are associated with different migration systems;
3. Ecosystem services, by influencing the development of a settlement, influence its potential to create migration under environmental change.

2.7 Conclusion

This thesis contributes to the field of environmental change and migration in several ways. Firstly, I seek to investigate the migration decision-making process under environmental change to take into account pre-existing mobility and propensity to migrate in the population. These elements have been under-analysed in existing studies and evidence. Secondly, I investigate for the first time the specific relationship between ecosystem services and mobility. Thirdly, the role of affective and identity aspects of the decision to migrate are under-represented in the migration and environment literature, especially attachment that can be formed to aspects of the natural environment. Furthermore, there is a dearth of theoretical frameworks for systematic understanding of the interaction of migration and the environment.

There will never be a uniting theory of environmental migration, in the same way that this is impossible in the area of labour migration. However, the framework presented here responds to the lack of individual-level frameworks on climate change and migration, dissecting environmental decision-making under environmental change and taking a first step towards a framework that can be applied quantitatively. The following chapter describes the research design and methods employed in the research.

3 Research design, data collection and analysis

3.1 Introduction

Chapter Two reviewed migration theories at the level of the individual, ecosystem services as a as a way of conceptualising wellbeing gained from the environment, rurality and diversity of rural livelihoods and sense of place as a way of understanding how people form attachment to their location. The state of knowledge on the links between the environment and migration and frameworks for its further investigation were also reviewed before presenting a new analytical framework for understanding the role of the environment in migration. This framework uses behavioural migration theory, ecosystem services and concepts of the role of place to produce a series of hypotheses. This chapter describes the research design and methods that have been used to test these hypotheses.

The research carried out for this study used a survey-based approach to collect information on personal characteristics of the population and individual attitudes and opinions to migration and their environment. The research was, however, multi-level, placing the individual in the context of household and the settlement, acknowledging the influence that both household livelihood strategies and sending area characteristics have on migration. Mixed methods were used to prove or disprove the hypotheses generated by the analytical framework. The empirical chapters make use of binomial logistic regression models, statistical analysis of qualitative data, non-parametric tests for differences between groups, frequencies, ternary diagrams and grounded theory approaches.

This chapter has five sections. The first section places the research design used in this study in the context of other designs researchers have used to illuminate the links between environmental change and migration. The second section justifies the choice of field site. The third section describes the sampling strategy used and provides some summary statistics of the population and settlements sampled. The fourth section describes the data coding and analysis carried out. In the fifth section I briefly address potential sources of error and bias as well as ethical considerations.

3.2 Selection, justification for and description of research design

Chapter 2 addressed the reasons why a behavioural approach, embedded in the individual and his or her migration decision-making process is the most appropriate for this research. The approach taken by this study is normative/socio-psychological as opposed to objective which would be based on studying broad patterns of migration (Boyle, Halfacree et al. 1998). The normative approach suggests the individual sample survey as the most appropriate research method although links between climate change, environmental change and migration have been analysed in various ways to date.

Method group	Technique	Advantages	Disadvantages
Ecological inference based on area characteristics	Correlation between environmental indicators and migration patterns at the aggregate level. Certain types of migration flows should be linked with certain kinds of environmental conditions.	Aggregate data relatively easily obtainable	A lack of appropriate environmental variables at the aggregate level; Subject to the ecological fallacy.
Individual sample surveys	Environmental influences on migration among the socio-economic influences, at the household level. Data collected through direct questions at the household level analysed in regression models or cross-tabulations.	Allows the drivers of migration to be separated	Environmental change over time often incompletely captured; Subject to the atomistic fallacy
Time series, multilevel analysis & agent-based modelling (ABM)	Time series analyses look at correlation between migration and environmental variables over time; multilevel analysis combines ecological and individual level data; agent based modelling is used to simulate the response of individuals to environmental change	Avoid both the ecological and atomistic fallacies	Multilevel modelling: Constrained by predefined spatial units for data, not necessarily matching phenomena under investigation ABM: insufficient information on which to base rules. Routine behaviours not that important
Qualitative/ethnographic methods	Interviews or small sample questionnaires with inhabitants of threatened areas; documental research to provide historical analogues.	Qualitative approaches well established Less methodological and data problems Insights into attitudes & perceptions	By definition cannot provide quantitative information how the environment is acting upon migration Not easily generalizable.

Table 3.1: Methodologies for linking climate change, environmental degradation and migration as identified by Piguet (2010). Piguet highlights six groups of methods: ecological inference based on area characteristics, individual sample surveys, time series and multilevel analysis, agent based modelling and qualitative and ethnographic methods. Individual sample surveys and a qualitative/ethnographic approach are the only approaches that elicit information on the individual's migration decision-making process, although such information could act as an input to an agent-based model.

Six distinct groups of methodologies have been identified by Piguet (2010): ecological inference based on area characteristics, individual sample surveys, time series, multilevel analysis, agent-based modelling and qualitative and ethnographic studies. Table 3.1 highlights the advantages and disadvantages of these methodologies as identified by Piguet.

An individual sample survey approach has been used in the past in the environmental migration field to quantify the 'role and weight of environment factors in already occurring human migration' (Piguet 2010; 517). Such exercises are rarely successful since the research is only able to stress the importance of environmental factors in the context of social drivers (Black, Adger et al. 2011). The criticism levelled at individual household survey approaches by Piguet is the inadequate treatment of environmental factors. Studies highlighted either interview people before and after a climate event or information is not collected on the evolving environmental conditions throughout the stages of a panel survey.

Surveys are, however, the only way to obtain information on attitudes and beliefs; they are the only way to obtain retrospective data on past moves and motivations for past moves, and they allow the collection of data from a large number of people rapidly and cheaply (Chadwick, Bahr et al. 1984). The survey for this research was a mix of questions seeking quantitative answers and open questions for which a short answer was required. Fully structured interviews with short or multiple choice answers are more appropriate to hypothesis testing (Chadwick, Bahr et al. 1984) and so these were used to collect background and historical information on the settlements as well as migrant histories.

The research design is based around determining the 'relationship of demographic traits to migration propensity' (Piguet 2010; 334) based on the characteristics of mobility potential and place utility. The research recognizes, as acknowledged by Lee (1966; 50), that 'we can never specify the exact set of factors which impels or prohibits migration for a given person, we can, in general, only set forth a few which seem of special importance and note the general or average reaction of a considerable group.' Piguet (2010) goes so far as to say that 'the idea of producing quantitative predictions of migration, assorted with probabilities of occurrence, is little more than a dream' (p.517) due to the role of human agency in choosing migration as an option over other forms of adaptation to environmental change.

The desire to assign migration propensity to different demographic groups rules out some other methods that focus that attempt to grasp subjectivity and social norms, such as Q methodology. Q methodology is a method that allows the quantification and statistical analysis of subjectivity (Barry and Proops, 1998) and focuses on the way in which different groups of world views form patterns with each other (Barry and Proops, 1998). The analysis is less concerned with the individual, than the 'combinations and configurations of themes which are preferred by the

participant group' (Watts and Stenner, 2005; 70). In this way it is more suited to understanding social views, shared perceptions and social discourses, than individual views and characteristics (Watts and Stenner, 2005). What can be extracted are 'idealised' forms of some discourse (Barry and Proops, 1998; 339).

Since this study uses behavioural migration theories, the level of the analysis was at the individual and involved aspects of their behaviour, which precludes the use of other methods such as large scale regression modelling. Some of the large scale regression modelling has used longitudinal survey data to link migration events with exposure to environmental stresses, taking into account potential confounders (e.g. Gray and Mueller, 2012). This life history approach whether carried out quantitatively through regression modelling, or qualitatively, using individual and detailed life histories, might have been another possible approach. However, this method seeks to find correlations between past environmental change and past migration with less emphasis on the mechanisms that lead to migration from environmental change.

The research design employed in this research has several key characteristics which aim to overcome some of these problems. Firstly, it concentrates on the role of human agency in migration and the causes of migration are those reported by the migrant. The aim is to understand how human agency and preferences alter the probability of migration occurring in an area, especially because of environmental change. Authors who have highlighted the need to understand variability in responses because of human agency and preferences in the context of environmental change include Lonergan (1998), Grothmann and Patt (2005) Black, Kniveton et al (2008) and Tacoli (2009)

Secondly, the approach is question, not methods driven. The analysis uses the most appropriate method available to answer each research question. Both qualitative and quantitative methods are used and qualitative survey responses are analysed qualitatively as well as being coded for non-parametric statistical analyses. Thirdly, the research is interested in the members of the population who have stayed in location, not those that have left. The research incorporates migration and mobility only with respect to people that have left and returned to the village, or people that were born elsewhere and are immigrants to the village. Finally, the research design focuses on understanding current use of ecosystem services to predict vulnerability to future environmental change. It predicts future migration using current mobility and utility characteristics, grounded in theory.

A weakness of the research design is that it does not validate the model it produces and the predictions the model makes. Such validation would require a panel study and sampling prior to and after environmental degradation; something that is beyond the scope of this thesis.

The following section discusses the choice of location for the research and the role of mountains as both hotspots of ecosystem diversity, but also history centres of depopulation, where migration systems are highly developed.

3.3 Low latitude, high altitude regions as environmental change hotspots

Mountain regions have impacts far beyond their geographic area due to the role they play in the regulation of water resources and climate. Glacier retreat is a high profile impact of climate change that has implications for water security of large regions; loss of glaciers, although having lead to an initial increase in water, will lead to water supply being much more seasonal and irregular. Although the technocratic aspects of glacial retreat are well studied, the human dimensions are much less understood (Carey 2010). The glaciers of the Andes are particularly vulnerable to climate change because of their location in the low latitudes.

Peru is a country highly vulnerable to climate change. Its vulnerability originates in its exposure to climate events such as El Niño, high levels of poverty and inequality, large numbers of people living in highly exposed areas, and diverse and fragile ecosystems endemic to small regions. The economy is highly climate sensitive since it is dependent on agriculture, fisheries and mining and Peru has within its boundaries it has ecosystems of global importance, such as the largest concentration of tropical glaciers in the world, and large parts of the Amazon rainforest (MINAM, 2010).

Peru is one of the countries of the world most affected by weather events related to El Niño. Extreme weather causes the majority of disasters in the country (floods, drought, landslides, hailstorms, and frost) and these events have been grown in frequency six times between 1997 and 2003 (MINAM, 2010). Climate scenarios suggest an intensification of El Niño with climate change. El Niño has been associated with crop cycles (such as mango and cotton in the north of the country) and fungal diseases in crops such as maize, potato, wheat and beans (Magrin et al, 2007). Studies also show that the temperature and precipitation regimes are changing throughout the country. Minimum air temperature is predicted to increase by between 0.4 and 1.4 °C. By 2030, the biggest decreases in annual precipitation are expected in the mountain regions (between 10 or 20 %) and in the north and central jungle (around 10%). The biggest increases in precipitation are expected on the north coastal region and the southern part of the jungle region (between 10 to 20%). A rise in sea level of between 60 to 81 centimetres is predicted in the next 100 years (MINAM, 2010).

In the last 30 years Peru has already lost 22 per cent of its glaciated area, equivalent to a loss of a 12000 million cubic metres of water. Around 50 per cent of the population lives in low coastal areas and it in these areas where the majority of economic activities occur. Unplanned urban

growth has left areas particularly vulnerable to climate risks due to their location. All glaciers located under 5000 metres are expected to melt in the next 10 years with implications for the availability of water in the coastal regions – by 2030 there could be a reduction in 6 percent in the availability of water on the Pacific coast as well as for hydroelectricity generation (Magrin et al, 2007). The majority of the population lives on the arid Pacific coast and depend on the water that originates in the sierra. The decrease in precipitation tied with melting glaciers will put pressure on the economic and population centres at the coast (Magrin, 2007; MINAM, 2010).

As well as a climate change impacts hotspot, Peru represents a hotspot of migration. Mountain areas are historic and current areas of depopulation across the globe (Williams and Griffin 1978; Devine 1983; O'Rourke 1999; Arnaez, Lasanta et al. 2011) and Peru is no exception. Urbanization towards the coast from the highlands has been the dominant demographic trend of the twentieth century. Between 1940 and 2004 the population of Lima grew from 663 000 to almost 8 million and it is expected to reach 10 million by 2015. This has lead to high urban supremacy and centralization and the perpetuation of emigration from mountain areas. Lima and the metropolitan area of Callao make up 29 per cent of the population of Peru and 70 per cent of the population of Peru lives on the coast. A decrease in rural population has not, however, accompanied urbanization due to natural growth in rural areas and the urban population maintains economic and cultural links to their villages through land tenure, property and family and friends (Golte 2001; Figueroa 2009).

The population of Peru is 28 220 764 (2007 census) and the population is expected to reach 43 million by 2050, based on current growth rates. Seventy six per cent of this population lives in urban areas while 24 per cent is rural. Thirty percent of the population lives in Lima, a result of the development of communication routes between the highland rural areas and the capital since the 1950s. The activities of the Shining Path during the 1980s lead to a surge in migration to the capital from the Andes (MINAM, 2010).

Agriculture and aquaculture are the biggest employers, employing 23.3 per cent of the economically active population. Other important activities are minor commerce and manufacturing. In 2007, 95.5% of the population were employed. With respect to levels of poverty, there is high inequality between rural and urban areas. Rural areas are not only poorer but wellbeing is increasing at a much slower rate. Sixty per cent of the population in rural areas is categorized as poor, with 21.1 per cent in conditions of extreme poverty. In comparison, in urban areas 23.5% of the population is considered poor and only 3.4 % considered in a condition of extreme poverty. These inequalities are demonstrated, for example, in access to mains water. Levels are now at 54.8 per cent of households. In urban areas, this is 68.8 per cent whereas in rural areas 50.6 per cent of households get their water from rivers, streams, springs or other natural water sources (MINAM, 2010).

Peru is in a period of growth, with gross national product growing a record 9.8 per cent in 1998. This growth is based in the development of the mining, hydrocarbon, commerce and construction sectors. The sectors that contribute most to production in Peru are manufacturing (15.5%), commerce (15%) and agriculture/aquaculture (7%). The growth of these sectors is closely linked to international prices, national conditions such as the production of raw materials, and changes in climate and availability of water. Traditionally, the economy of Peru has been based in the exploitation, processing and exportation of natural resources, specifically mineral, agricultural and marine products. More recently, the economy has been supplemented by the light industry, construction, manufacturing and service industries, facilitated by an international context favourable to the exportation of goods and services (MINAM, 2010).

With respect to climate change Peru, like elsewhere, is subject to multiple stressors (cf. O'Brien, Leichenko et al. 2004). Agricultural output has been affected by both high inter-annual variability in climate driven by the El Niño Southern Oscillation among other processes as well as successive interventions of the government into the agricultural sector and, most recently, market forces(Crabtree 2002). Climate change impacts are likely to make life even more difficult for farmers. Projections show Peru receiving less precipitation in all parts of the country, and an increase in extreme weather events is expected with an increased frequency of the El Niño Southern Oscillation. Rises in temperature are expected to lead to increases in summer temperature, decreases in summer humidity and decreases in number of days with frost during the summer (Comisión Nacional de Cambio Climático 2001).

Any change in water resources has stark implications for Peru where the distribution of the population and the presence of irrigated agriculture are almost opposite to the availability of water. The coastal region of Peru is home to 70 per cent of the population, however, it benefits from only 1.8 per cent of the water resources in the country. In this arid region, 68 per cent of the country's irrigation infrastructure is used to produce export crops (Comisión Técnica Multisectorial 2004; Hepworth, Postigo et al. 2010).

The Rímac river valley on the central coast of Peru was the field site selected for this work. Although a small river basin, it is of high strategic importance supplying water and hydro-electricity to Lima. It is a microcosm of wider Peru with respect to the migration and environmental issues discussed above: it has glaciated headwaters and its watercourse is highly managed. There is a wide range of rural incomes as well as large range of agricultural practices along the length of the valley and migration to Lima dominated over the latter half of the 20th century. The river basin has a surface area of 3398 km^2 and a length of 134km. The highest point in the watershed is 5508 metres above sea level and the river runs west to drain into the ocean at the port of Callao, part of the wider Lima metropolitan area.

The following section describes the Rímac valley in more detail, provides details on the sampling strategy employed and summary statistics for the surveyed populations.

3.4 The Rímac valley, its population and its livelihood activities

A central feature of the valley is its transport infrastructure and ease of access to Lima. Alongside the river runs the *carretera central*, one of the major trunk roads of Peru linking Lima to Huancayo, the most important city in the central highlands, and to the central jungle. In parallel to the river and the *carretera central* is a railway, originally important in taking agricultural produce to Lima but now used predominantly by the mining industry.

Migrants from the central highlands arrive in Lima on the *carretera central* from the east and so tend to settle in the eastern parts of Lima. Early migrants to Lima (parents or grandparents of people interviewed) now live in central parts of Lima such as La Victoria or Valdivieso. Those that have migrated more recently settled on the eastern edge of Lima in places such as Ate-Vitarte. The newest migrants buy land in informal settlements such as Huaycán and Amauta, even further out of Lima and further along the *carretera central*.

Peru is already a highly urbanized and centralized country with an expanding agricultural frontier. The highly motivated individuals in the survey area migrate to Lima to access education and employment opportunities; the more adventurous head to the agricultural and development frontier in the jungle. The mining industry is another force that continues to drive migration between rural areas. Lima acts as a distribution centre for economic migrants from the provinces out to other provinces. Many immigrants to the area arrived because of the location of the settlements on the *carretera central*.

Flow in the Rímac basin is tightly managed due to its strategic importance both for water supply, but more importantly, electricity generation for Lima (Rivera G. 2010). The Rímac sub-basin has one reservoir (at Yuracmayo, constructed in 1995) which regulates flow in this branch of the basin. Mining activities pollute the flow at the watershed so the water is unfit for human consumption and, in the main, irrigation. A minority use river water for irrigation (to the detriment of the crops). Both potable water and irrigation water is sourced from seasonal or perennial springs, and occasionally in the high basin from lakes. Wet season rainfall is the determinant of dry season flows for irrigation in many locations. Snowpack helps maintain springs longer into the dry season. There are two small glaciers in the Rímac basin, covering an area of 11.5 km^2 (Plan de desarrollo local concertado de la Provincia de Haurochirí, 2009) although sufficient and stable precipitation during the wet season is more important than glacial extent in maintaining dry season springs.

Farmers cultivate various crop groups, each serving a different purpose to the household and requiring a different set of climate conditions. Famers grow alfalfa to feed animals or sell locally or in Lima. Potatoes and other vegetables are subsistence crops. Farmers grow fruit in the milder reaches of the valley for sale, the variety of fruit grown dictated by demand. Flowers are one of the least profitable groups of crops, grown at higher altitudes in the lower part of the valley during the dry season.

There is diversification within households in the kind of livestock raised, with two or three types of animal (cattle, sheep, pigs and llama) common and many people raising guinea pigs for their own consumption or commercial sale. The number of livestock owned varies greatly between farmers. Some own several hundred animals that are put out to pasture in the higher altitudes. Others had numbers of animals in the tens, others less than ten or a single animal.

Levels of poverty prevent investment in better agricultural techniques and many people are relying on crops that are no longer profitable (e.g. flowers in Surco). Unsustainable agricultural practices have lead to land degradation and the increased use of fertilizers and insecticides (Bebbington 1997; Mayer 2001) requiring more financial input to maintain the same agricultural output, all in the face of more competition and falling prices for their products. It is in this context that environmental change is taking place.

The Rímac valley is vulnerable to climate change especially in terms of changes in precipitation patterns for irrigation and dry season pasture and temperature changes for crops. The ways in which climate variability and change is currently being experienced in the valley are highlighted in the sections below. The information is extracted from a section in the survey which asked a series of question on changes in the climate. There were two distinct sets of problems in the lower valley and the upper valley relating to changes in the temperature and precipitation regime. The characteristics of the lower valley and potential impacts are highlighted below:

- Diversity of ecological zones and crops available to the community: Climate will move the ecological zones and the crops produced to higher altitudes giving farmers a more diverse range of ecological zones to farm.
- Profitable agriculture dependent on irrigation: Requires stable and sufficient rainfall in the wet season to enable dry season agriculture. Rainfall is less consistent and reliable than in the past.
- Plagues a problem for crops: With the increased intensity of farming methods and cropping patterns there has been an increase in plagues. Increases in temperature combined with erratic rainfall leads to further increases.

The characteristics and vulnerabilities and opportunities are different in the upper reaches of the valley:

- High altitudes where there is limited agriculture: Likely to benefit from the warmer temperature with climate change because of an increased thermal growing season.
- Livestock raising on pasture: Pastures are mostly non-irrigated and require good dry season rainfall to sustain the grass during the dry season. Rainfall is less consistent and reliable than in the past.
- Livestock raising requires alfalfa in the dry season: Alfalfa requires irrigation and stable wet season rainfall. Rainfall is less consistent and reliable than in the past.
- Unseasonal frost a problem for crops: More frost, hailstorms and other extreme weather events are predicted to increase with climate change.

Two villages along the Rímac in different climate zones (San Mateo and Surco) and two villages in a rural tributary of the Rímac (Chocna and Caruya in the Río Blanco valley) were sampled. Choosing to sample these villages represented a stratification of the population by different availability of ecosystem services. Each settlement has a different climate, land availability, different form of land tenure and use of, and access to, ecosystem services. In addition, each town has different socio-economic characteristics: levels of access to the capital; natural resource wealth; availability of education, opportunities for off-farm and formal employment. The research does not include Matucana, a town that sits at 2378 metres between San Mateo and Surco, because it is the administrative capital of the province of Huarochirí and this has affected the population composition and range of employment opportunities.

Chocna is a small agricultural annex with poor access to the district centre. Income sources are predominantly farming and limited to livestock raising and subsistence agriculture. Caruya is another small agricultural annex, with easy access to the main trunk road to Lima and to mining centres, and the district centre. Incomes in the village are diverse between farming and off-farm sources. San Mateo is a commercial district centre, with a diverse range of off-farm income sources but very little farming. Surco is a district centre which is diverse within farming, and in the mix of farming and off-farm households. Figure 3.1 shows the locations of the settlements with respect to Lima and within Peru. Table 3.2 provides summary statistics of the settlements.

Town	Chocna	Caruya	San Mateo	Surco
Altitutde (masl)	3940	3535	3149	2018
Ecological level	Alpine pluvial tundra	Sub-alpine grassland	Sub-alpine grassland	Montane desert scrubland & dry forest
Pop. (2007 census)	85	80	5280	1798
Distance to Lima (km)	108	102	93	67
Mean age	48	42	43	47
Secondary education (% of pop.)	48	81	70	58
Access to land (% of pop.)	91	94	27	86
Households with farming & off-farm income (%)	10	67	25	41

Table 3.2: Summary statistics on altitude, ecological zone, population, access to Lima, levels of education, access to land and access to off-farm income sources for the four settlements surveyed

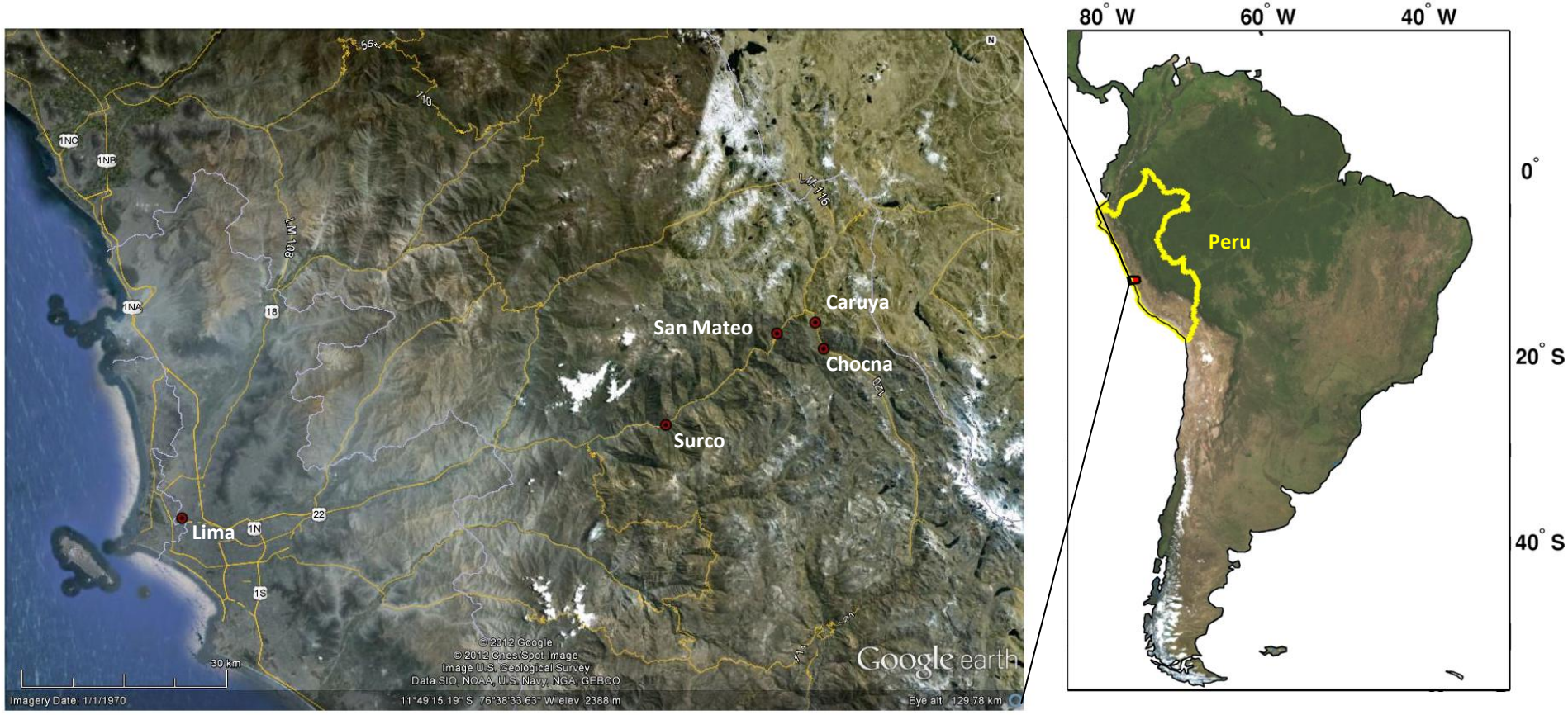

Figure 3.1: Location of Peru within Latin America, the location of Lima and the Rímac Valley within Peru, and the location of the four villages sampled in this research with respect to Lima. Chocna, Caruya and San Mateo are located between 3350 and 3135 metres above sea level in ecological zones of alpine pluvial tundra and sub-alpine grassland. Surco is located at 2018 metres above sea level in a zone of montane desert scrubland and dry forest.

At the altitudes of Chocna, Caruya and San Mateo there are lands for growing pastures in the valley bottom and land for pasture on the hilltops. The community gives members land to farm, as well as access to the communal pasture. Animals are put to pasture in the first few years of their life until they are of producing age, when they are brought down to the village. Crops are rotated every three years to let the soil rest. Community members may have more than one plot of land in different locations on the hillside. Due to this rotation of land, farmers use more modernized forms of irrigation because it is easier to move hoses and sprinklers than to reconstruct furrows for flood irrigation. Irrigation is not ubiquitous and some people grow only during the wet season, or grow only potatoes that can survive underground during the dry season.

In Surco, due to the Mediterranean climate, most community members have orchards of various fruit trees. Farmers do not rotate crops or leave fields fallow since fruit trees are perennial. This has also influenced the choice of irrigation method. Flood irrigation predominates with farmers having over the years created and maintained furrows to irrigate their crops. Because of the nature of the crops grown, wet season harvests are rarer – the flowers of fruit trees and flowers for sale are ruined by heavy rains.

In places like Surco and Chocna the levels of poverty prevent investment in better agricultural techniques, and many people are relying on crops that are no longer profitable (e.g. the cultivation of flowers in Surco). That is to say, many farmers are unable to adapt to changes in market forces effectively; they have already been left behind. Furthermore, unsustainable agricultural practices has lead to land degradation and the increased use of fertilizers and insecticides, as found throughout the Andes (Bebbington 1997; Mayer 2001) requiring more financial input to maintain the same agricultural output, in a context of increased competition and falling prices. In this sense, many of the residents of these settlements are already scraping by in very sub-optimal conditions; if they could have migrated to improve their place utility they would have already done so.

Climate change is just another external force on these villages with a way of life that has already been drastically altered by political change and economic development. The way a settlement has developed and coped with change in the past is important for knowing how change will affect it in the future. The rural communities are hardened to change because they have survived multiple socio-economic upheavals –agrarian reform, political violence and the implementation of neo-liberal economic policies. The boomtowns which are thriving as a result of mining industry have yet to survive such tests, and in the past closures of mines have lead to population dispersal.

In these rural locations the population has a high degree of adaptability to climate and other shocks. Unlike in urban areas, they do not relying on government or private actors to resolve issues such as shortages of water or the breakdown of an irrigation system and instead pull upon

social networks. Furthermore, in these locations people have a range of income sources, while none maximise returns on labour, there is a range of ways to survive, for example though informal day labour, subsistence agriculture and occasional migration to other regions.

Immigrants constitute significant proportions of the population in certain of the settlements studied and the ways in which they have or haven't formed attachment to their residence has an impact on the kind of migration that may occur due to climate change. It would be easy to suggest that immigrants did not form the same kind of attachment to place as those that were born in the location, but immigrants can compare the settlement to other places and in fact may appreciate its characteristics more.

When looking at trends in agriculture and the sustainability of the way of life of the smallholder farmer, it emerged that rural institutions, through their control over the distribution of land, can inhibit the changes that are required to re-energise agricultural production in the area. Access to land in the villages is controlled by agricultural communities (comunidades campesinas) and is interacting with migration and mobility in two ways.

Firstly, In order to have access to land a person has to be a member of the agricultural community and this difficult for new residents to achieve. Migrants to the area are prevented having access to farmland by conservative institutions that, at times, take pride in preventing the newcomers from becoming members of the community. Therefore, new migrants cannot access land, preventing them from forming bonds to the land and making them, potentially, less likely to be affected by changes in agriculture as a result of environmental change. This is occurring simultaneously as, and is a direct result of, the fact that emigrants from the village maintain their land even though they are no longer resident in the village. A piece of agricultural land left fallow for more than three years returns to the ownership of the community. This practice has benefits for the benefits to the migrant and the disadvantages to the sending area of maintaining access to land have been documented (e.g. helping to maintain cultural bonds, security nets for when migration episode is unsuccessful) (Golte, 2001; Winkels, 2008) but this also has implications for mobility as a results of changes in the environment. In this sense, early out-migrants are preventing later in-migrants from fully integrating into the rural lifestyle which has implications with environmental migration. Access and entitlements of immigrants to farming is much lower.

The mining industry is another important driver of migration and development in Peru and in the field area in pariticular. San Mateo is a town that has boomed in recent years due to the presence of the mining industry and many open mines nearby. This means that migrants are drawn to the area from all over the country from other mining centres. Furthermore, the closing of a local mine and its subsequent reopening (Millotingo) was a big driver of mobility locally. Conflict over water resources between local communities and the mining industry are common across the highlands

of Peru; extractive industries are highly water intensive. In this sense extractive industries may be as vulnerable to climate change as agriculture in the highlands. And highland settlements, although some have grown as a results of the presence of mining will find their vulnerability to changes in water resources amplified by conflicts over those resources and uneven power relationships (Bebbington and Bury, 2009).

3.5 Sampling stratified by altitude to access different suites of ecosystem services

The Rímac valley is suited to the study of the interaction of environmental change and migration because it provides both a wide range of climate zones and socio-economic factors (e.g. land management practices and employment opportunities). It has a complex migration landscape driven by the presence of transport routes, proximity to Lima, its past as an agricultural centre and the presence of mining centres which allows the investigation of environmental drivers of migration in the context of existing mobility. Furthermore, there are similar boundaries for both the hydrological system and migration network since Lima is the major migrant receiving region for this valley (and Peru in general); this has implications for the vulnerability of the migrants at their destination since they will be part of the same hydrological system. Finally, on a practical note, this area provided the geographic and cultural accessibility as well as a Spanish-speaking population that enabled a rapid, quantitative and randomly sampled survey to take place.

Empirical data collection centred on a household survey with a mix of quantitative and qualitative questions. Data collection involved 444 surveys in total in the four locations. Of those, 433 were valid. Reasons for excluding surveys include interviewing more than one person in the same household or the person usually residing outside of the village. Appendix 1 provides the maps used for sampling while Appendix 2 provides the survey in full while Appendix 2. Table 3.3 shows data collection statistics by village surveyed.

The survey contained nine sections: 1) land access, farming activities, crops and agricultural cycle, numbers and types of livestock and limitations on livestock; 2) level and type of irrigation in the farm, limitations on water resources and actions taken when irrigation water is in short supply; 3) availability and stability of water in the household and actions during water shortages/when supply is cut off; 4) changes in the crops cultivated and reasons for the changes; 5) climate and the ways in which it affects the life of the respondent, whether the respondent has observed changes in the climate and the nature of these changes; 6) characteristics of household members, migration event histories of the household heads and any other adults living in the household (as recalled by the respondent), number of children under 16; 7) migration networks: location of offspring and siblings of the respondent; 8) migration motivations, and various measures of attachment to place; 8) characteristics of residence as a measure of wealth.

	Chocna	Caruya	San Mateo	Surco
Population (approx.)	85	80	5280	1798
No. of houses in sampling frame	21	18	767	305
No. of houses sampled	21	16	446	303
% of houses sampled	100	89	59	99
No. of individuals spoken to	21	16	196	156
No. of "non-sample" houses	0	0	31	13
Total no. of households surveyed	21	16	227	169
% of population	25	20	4	9
No. of migrants interviewed from the village	7	1	4	9
No. of expert interviews	5	0	4	5

Table 3.3: Number of surveys carried out and proportion of the population covered. Size of sampling frame and sample size for the four survey locations. All households in Chocna and Caruya were sampled, bar those that declined to take part. San Mateo and Surco were randomly sampled. Town plans created in February 2010 showing all the buildings in the village provided a sampling frame in the absence of reliable lists of individuals. Simple random restrictive sampling involved numbering each house on the map and selecting houses with a lottery method.

The populations of Chocna and Caruya are very small and all the households within the village, so interviewers were able to interview all households in the village except those that declined to take part in the survey. Random sampling took place in San Mateo and Surco because they are relatively large population centres. Since there were no reliable lists of all inhabitants in the village from which to sample, houses were sampled using town plans created in February 2010 and obtained from the Municipality in April 2010. The survey used simple random restrictive sampling; each house on the map was numbered and selected for sampling using a lottery method.

This method of sampling was chosen because the characteristics of the population were unknown before starting the data collection and the research questions did not investigate one particular population that would require purposeful sampling. The small geographic area also meant that there was no difficulty in reaching the randomly selected houses. However, although the most recent available and sourced from the village municipalities, the maps omitted newer houses on the margins of the settlement. The sampling strategy therefore also included positive sampling of these newer areas in San Mateo and Surco. The additional households do not differ statistically from the households in the sampling frame with respect to characteristics of interest in this research.

The reason that the number of households sampled is much higher than the number of interviews obtained is that a large proportion of the houses sampled failed to yield an interview. This was for various reasons. In San Mateo, it was due to people declining interviews, derelict houses, unoccupied houses or non-residential buildings. In Surco, buildings for which we obtained no

interview were often the houses of people that spent most of their time in the rural annexes, but more often than not were empty plots of land.

The survey randomly sampled households but not the person within the household. Interviewers made an effort to interview a household head, and preferably the male household head, on the assumption that he had the decision-making power in the household. Often, however, the male head was unavailable due to long shifts or was absent from the household. It was also unclear as to whether the decision-making power in the household did by default rest with the male household head. Of the 433 people interviewed 40 per cent (f=173) were male and 60 per cent (f=260) were female. Thirty-seven per cent of household heads were female and 27 per cent were male. Other household roles of interviewers included single household heads (26%); child of the household head (8%); sibling of the household head (3%) and parent of the household head (<1%).

The sample is representative by settlement. Random sampling took place of households within settlements. The settlements were chosen to represent the conditions at a specific ecological level corresponding to a certain altitude. Ideally, one would have picked a settlement in each of the recognized ecological zones, or at a regular distance from Lima. However, trying to make the sample representative of any population would have been impossible due to a lack of reliable lists of the population. Therefore, individual villages were chosen, two district centres in different climate zones, and two different rural annexes and different altitudes. The sample is therefore skewed towards San Mateo when the data is treated is combined into one data set since San Mateo hadthe largest population by a significant margin. The incorporation of both district centres and rural annexes allowed the data to be analysed in both the context of different ecological and climate zones, and different socio-economic characteristics.

If time and financial constraints were not an issue, different ecological zones could have been identified and demarcated (between different altitudes). The watershed boundary could have been used as a lateral boundary. The different households within these climate zones could have been identified by mapping and initial data collection, then sampled. In order to have a population of individuals, not households, one would have to gain access to the voting register, but even those lists in this rural setting were unreliable and extremely out of date. If such lists had been available the sample could have been stratified by and made representative for income groups, job type, gender. However, there was no *a priori* knowledge on which of these socio-demographic characteristics was going to be important for the research questions so there was no guide for stratification, other than by altitude.

In order to have a more representative sample, the study could have taken place in a much smaller valley where the whole population of the watershed could be easily accounted for.

However, such a location would be at a higher and more remote where migration the social aspects of rural life would be less developed, and the investigation of the socio-ecological interactions, and the migration systems, less important.

The research had three levels of analysis: the individual, the household and the settlement. All three levels are required to respond to the hypotheses presented in Chapter 2. The individual is the unit of analysis for satisfaction, place attachment and mobility potential because these characteristics are either intrinsic to a person, based on their personal experiences or a result of his or her psychological and personality differences.

The research puts the individual in the context of the household or the village in which he/she lives, since these things affect the satisfaction of a person and their ability to act on their dissatisfaction and mobility and is a well-established unit of analysis. The household is a "social unit defined by the sharing of the same abode or hearth…a sub-set of the family, though the extent to which families may be split up among separate households again varies across different societies" (Ellis 1988; p.13). At the household level, the research considers current mobility, degree of reliance on farming and barriers to migration (Stark and Bloom 1985; Ellis 1988; Mayer 2001).

Information analysed at the level of the settlement includes information on levels of agriculture, material wealth and collective attitudes to place as well as migration systems. There is a rich history of research into the impact of sending area characteristics on out-migration that take into account variation at the level of the individual (Bilsborrow, McDevitt et al. 1987; Bilsborrow 1992; Ruitenbeek 1996; Massey, Axinn et al. 2007; Gray 2010; Gray 2011).

The research employed the same survey instrument throughout all the settlements in order to be able to compare between them. However, it meant that parts of the surveys were more appropriate in some villages and weaker in others, and the quality of the answers changed accordingly. This means that cross comparisons are sometimes difficult to make despite the questions remaining constant because the responses to the less appropriate questions were of poor quality.

Although based in the fundamentals of a livelihoods approach, I did not carry out a full livelihoods survey due to various issues that arose during initial testing of the surveys. Respondents identified by random sampling were rarely willing to give up the time required to answer the full raft of questions involved. Furthermore, people became suspicious and guarded if questions were asked about the assets they owned and many people lacked the information with which to answer the questions. Finally, interviewees and interviewers were not familiar with some of the tools of the survey, for example, scales and rankings.

At some points in the analysis, qualitative information supports or adds to findings from the quantitative analysis. Semi-structured interviews with migrants from the survey area now living in Lima and key informant interviews with specialists and community leaders within the survey area provided these qualitative data. Twenty-five semi-structured interviews were carried out with migrants from the four villages surveyed who had moved to Lima. The research focused on migrants to Lima for various reasons. Migrants were initially located by asking respondents in the villages if they could provide contact details of a sibling that had moved to Lima. The few addresses and telephone numbers obtained allowed for snowball sampling of other migrants from that area in Lima and the identification of new pockets of migrants. Snowball sampling was used because it 'is useful when there is difficulty in identifying members of the population' (Robson 2002: 266), which migrants from specific villages spread across the nearly nine million inhabitants of Lima were. A third way of encountering migrants was to interview them when they were back in their home village for holidays or weekends. The exploratory aspect of this part of the research required semi-structured interviews over more structured survey instruments.

Key informant interviews revealed additional information about the field area and background on some of the topics that had arisen in the quantitative surveys. Informants included elderly residents of the villages (a mechanic, senior members of the community, teachers); leaders of the *comunidades campensinas* (Yuracmayo, Caruya, San Antonio, Surco, Ayas); industry experts (retired mining engineer, engineer at the Yuracmayo reservoir) as well as especially talkative and experienced farmers and agriculturalists (especially in Surco).

The following section briefly explains coding and analysis of the data provided by the surveys and methods used to answer the research questions.

3.6 Data processing, variables and analyses used

The data obtained from the survey was scalar, categorical and ordinal in its nature. Categorical data was in the form presence/absence responses and short-answer qualitative responses. I coded short answer questions using a grounded theory approach: open coding of all responses to one question, followed by the development of themes, which were selectively coded to create categories that could be analysed statistically. Where required, groups were compared using non-parametric statistical tests (e.g. Kaplowitz 2000).

Table 3.4 presents the research questions and the variables used to answer these research questions. The data include both variables and data direct from survey responses and measures created by combining and further analysing variables from the survey. The analysis in Chapters 4 and 5 disaggregates the population by income group of the individual and past migration history of the individual. Results are only generalizable as far as the survey population. Analysis in

Chapter 6 disaggregates the population by settlement. Since the research design involved representative sampling, these results are representative of the entire settlement.

Binomial logistic regression models were run to understand the characteristics that contributed to place utility. The statistics package SPSS was used to run the models and independent variables were chosen based on studies of the factors that tend to create wellbeing and higher satisfaction in the population. Microsoft Excel was used to calculate new measures from variables in the survey.

Job types of the respondents were grouped into five different categories based on the stability of the form of income and the amount of security it provides (based on Mayer 2001): formal dependent (21%); informal independent (16%); informal dependent (4%), housewife (35%) and farmer (24%). The formal dependent group included any respondent with salaried employment. The informal group included anybody who was self-employed and owned some kind of capital, whether it was a dry goods shop or a stall in street. The informal dependent income group had the least stable income source and was composed of people that worked for others on an ad-hoc basis, e.g. day labourer, washing clothes. Farmers could have been included in the informal income group, but were separated for analytical purposes due to the very different kind of lifestyle and risks that farming entails over commercial enterprises.

The research concentrates on those that have stayed in location and decided not to leave the place in which they lived. Therefore, for the purpose of this research, any person who had lived in another place than that in which they grew up, and had moved residence as an adult (i.e. not with their parents) is considered a migrant. This includes individuals who had migrated to Lima and retired to their birthplace; people who had relocated for temporary work contracts; people who had two households in different locations and constantly moved between them; and people who had moved short distances to new settlements in the same district. The need to relocate to access a different lifestyle and set of services that are not available in a person's home village defines migration, more than distance, duration or crossing an administrative boundary. The terms mobility and migration are used interchangeably and broadly to describe any length of stay outside of the place in which the respondent was born and grew up. Based on this, the population was divided into four different groups based on the migration history of the respondent: non-migrants (25%), return migrants (31%), immigrants (42%) and return immigrants (11%).

Chapter	Variables and measures	Sub-sample
Chapter 4: Interactions of place utility, mobility potential and barriers to migration	– Considered_migration – "Have you ever thought of leaving?" – Satisfaction scale – "How much do you like living here on a scale of 1-7?" – Quality_of_life – "Has life in the village improved, worsened or stayed the same?" – Age, level of education and gender – Time_stable – Age minus age at last move – EMPLOYED_AWAY - Does the respondent or their partner usually work outside of the village? – Children_Lima - Number of siblings in the city of Lima – Farmers – Self-reported job of the respondent farmer – MINORS – Children 16 and under living in the house – DEPENDENCY_RATIO - Workers divided by household size – Migration_driver - Reason for having thought of leaving (coded) – Migration_barrier - Reason for staying although thought of leaving (coded) – EDU_SEC – Has completed primary education or above.	• Income group of the respondent • Migration history of the respondent • Dominant income group of the household
Chapter 5: Contribution of ecosystem services to place utility and the relative roles of instrumental versus affective bonds to ecosystem services	– "Money_migration - "Would you leave tomorrow if you had the money?" – Money_reason – Reason for staying/leaving – Farm_off_farm – Household income farm-based, off-farm or mix – Other_pos - "What things do you like about life in the village?" (coded) – Job_grp – Job group of the individual categorized as formal, informal, formal dependent, farmer or housewife – Climate – Mentioned climate as a positive characteristic of life in the village – Farming - Mentioned farming way of life as a positive characteristic – Unpolluted – Mentioned lack of pollution as a positive characteristic – Env_aesth –Mentioned the beauty of the natural environmental as a positive aspect – Just_leña – Cooking fuel is only wood – Leña_other – Cooking fuel is wood plus gas/kerosene	• Income group of the respondent • Migration history of the respondent • Dominant income group of the household

Chapter 6: Influence of place specific factors on the decision to migration	– Other_pos - “What things do you like about life in the village?” (coded) – Climate – Mentioned climate as a positive characteristic of life in the village – Farming - Mentioned farming way of life as a positive characteristic – Unpolluted – Mentioned lack of pollution as a positive characteristic – Env_aesth –Mentioned the beauty of the natural environmental as a positive aspect – Farm_off_farm – Household income farm-based, off-farm or mix – MIGR_CAT – respondent categorized as non-migrant, return migrant, immigrant or return immigrant – Farmers – Self-reported job of the respondent farmer – ENVMEGA - Mentioned an ecosystem service as a positive characteristic of life in the village – Considered_migration – “Have you ever thought of leaving?” – MOBILE – Aged 30 or under with secondary education – “Money_migration - “Would you leave tomorrow if you had the money?”	• Settlement

Table 3.4: Variables, measures and sub-samples used to test the hypotheses of the thesis. Research questions and sub-questions and how they relate to the components of the analytical framework; variables sub-samples used to answer those questions. The first two sets of hypotheses use the population disaggregated by income group and migrant group and the results can only be generalized to the sample. The final chapter disaggregates the sample based on the settlement and so that results can be generalized to the level of the settlement.

3.7 Reflection on methods

The research methodology was predominantly quantitative and based, implicitly, in the New Economics of Labour Migration where migration is conceptualised as a livelihood risk diversification strategy among local farm and off-farm income sources. In the analysis, a migrant was classified as someone who had lived outside the village where he or she had grown up. This approach was appropriate because the focus on those that had stayed, those that didn't use migration. Migration histories were captured for all the respondents – all migration episodes, timings, justifications and barriers. These were coded for the purposes of the analysis into categories – number of moves, type of move (permanent/temporary; for family/for work). Migrants from the villages were identified in Lima and interviewed in order to verify the motivations for migration.

The focus of the research was on the present, or how the past and present situation may affect future decision-making, not on why certain decisions were made in the past. An approach based in the qualitative analysis of migration histories would have been useful if trying to tie migration events to certain significant or unusual climate events such as droughts, floods or cyclones. In this case however, care would have to be taken to ensure that the recall of the individual was as accurate as possible (e.g. by relating all migration events to well known events in the past such as marriages, birth of children).

Sense of place was explored using a uni-dimensional measure. While uni-dimensional measures have been employed previously (Lewicka, 2010), a multi-dimensional measure would have provided a richer analysis of the ways in which people form emotional bonds to their location. Mendoza and Morén –Alegret (2013) outline methods specifically for investigating sense of place in migrants such as semi-structured interviews, non-representational theory; and biographical analyses, focus groups; as well as quantitative surveys which attempt to break down the different dimensions of sense of place. Burholt (2012) created a four-domain model of attachment to place – physical, social, temporal and sociological and analysed data using principle component analysis to identify three factors of place attachment. Therefore, there are many methods available for a more multi-dimensional analysis of sense of place, which this thesis failed to avail itself of fully.

The research focused on the contribution of ecosystem services to sense of place, and in particular, the non-material ecosystem services, grouped under the title of 'cultural' ecosystem services. Since the Millennium Ecosystem Assessment there have been huge advancements in how we define, understand, capture and measure the non-material values of ecosystems (e.g. Chan et al, 2012; Daniels, 2012; Satterfield et al, 2013). To really capture the ways in which ecosystem services contributed to place attachment would require both a multi-dimensional

measure of place attachment, and a measure of place attachment that allowed ecologically-relevant values and attitudes to be incorporated.

One final note is cultural ecosystem services and migration decision-making, while studied here at the level of the individual, are both understood as part of, and influenced by, social norms. As highlighted in the literature review, many cultural ecosystem services are less of a 'thing' and more of a process, such as worldviews, symbols, assets and institutions practices and forms valued at the level of a society. Migration decision-making is influenced by the situation of others around the potential migrant as in the New Economics of Labour Migration which argues that migration is undertaken as a household, individual strategy, and that a household may chose to fund migration based on a relative, not absolute, loss of income compared to neighbours. Migration is perpetuated by social networks and social capital in destination locations. Furthermore, in some places, migration is considered a rite of passage, or it is the norm to live between two locations and this will influence individual decision-making.

While acknowledging these higher level influences on the individual, and the complex ways in which a person may gain benefit from ecosystem services, this work focuses specifically on the individual's place utility and the potential contribution of ecosystem services to that utility. This forms an important part of the larger picture.

3.8 Conclusions

Research questions addressing the migration decision-making process require a micro-level survey research design to obtain views, opinions and perceptions of the individual. In addition, the approach here places the individual decision-making process in the context of the household while taking into account the effect of sending area characteristics on migration. The research design is different from others in the environmental migration field to date as it addresses why people stay rather than why people migrate. Finally, an important and novel aspect of the research design is that it looks at future migration potential due to environmental change by examining characteristics of the population in the present. A flaw of the research design is that it cannot validate the model it creates.

High mountain regions have a history of depopulation and well-developed migration systems. They are also experiencing the impacts of climate change rapidly due to their high altitude. The Andes mountain range dominates the geography and socio-economic development of Peru; there have been high rates of urbanization but rural population levels persist. The Rímac valley is strategic because it supplies electricity and water to the capital city of Lima.

The research design stratifies the sample by ecological level; four villages were selected in three ecological levels. Interviewers used town plans to carry out random sampling within the villages at

the level of the household. The survey produced 433 usable responses that were analysed by income group, migration history and town level. The analysis took a mixed methods approach. New measures were created by combining existing variables. Qualitative responses were coded and categorized to allow for quantitative analysis. Some categorical responses were analysed using binomial logistic regression and findings were supported with qualitative examples.

Having described the approach that the research takes and justified the choice of field area in this chapter, the next chapter describes results of the first empirical analysis. It focuses on breaking down the migration decision-making process and understanding the ways in which place utility and mobility trade off against one another to prevent migration from occurring.

4 The migration decision-making process

4.1 Introduction

Chapter Two provided the rational for the examination of behavioural migration theories in preference to other migration theories with respect to understanding the interaction of environmental changes and migration. Chapter Three described the social survey that took place in order to collect data on the decision-making process. This first empirical chapter presents the results of implementing behavioural migration theories in the field. It examines how place utility, mobility and barriers interact to encourage or prevent migration as a response to residential stress, over adaptation in place, or raising expectations and stress thresholds.

The chapter responds to three hypotheses presented in Chapter Two which are extracted from behavioural migration theory: that populations contain members with both positive and negative place utility and initiating the migration decision-making process represents a shift from positive to negative place utility; that high mobility potential and negative place utility individuals are likely to be emigrants in any population and therefore absent or at low numbers in traditional sending areas; and that if such individuals are present they will be subject to resource barriers to migration.

High place utility is a function, in part of the population, of low mobility potential. The chapter tests these hypotheses using data extracted from two survey questions 'Have you considered migration in your last period of residence in the village' and 'if you considered migration, why didn't you leave?' These questions were used as proxies for drivers of dissatisfaction and barriers to migration respectively. The responses as a whole sample and disaggregated by income type and past migration history of the respondent. The analysis takes place at the level of the individual, taking into account the household context.

The chapter begins by examining negative place utility in the population, how it is created and whether it can be predicted. To reveal the different phases of the migration decision-making process self-reported barriers to migration are used. An examination of socio-demographic predictors of migration takes place and a comparison made to mobility as defined by behavioural migration theory. Finally, the behavioural migration approach to looking at migration is put in the context of other common influences on migration namely, household factors and past mobility behaviour.

4.2 Quantifying and predicting negative place utility and understanding its causes

The migration decision-making process begins when an individual's place utility changes from positive to negative and the individual starts to experience dissatisfaction with place or residential stress. Therefore, residential stress in an individual can be investigated empirically by finding out whether they have considered changing location in their last period of residence (following the approach of Speare 1974). Referring back to the place utility/mobility quadrants presented in Chapter Two, this section addresses the place utility axis, as highlighted in Figure 4.1

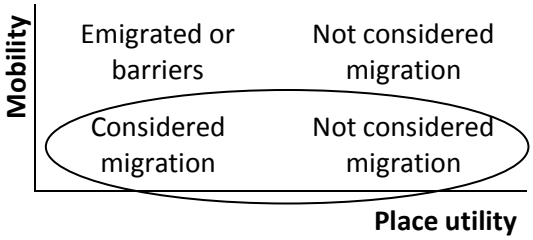

Figure 4.1: Place utility and mobility potential combinations that are possible in the population. Section 4.2 addresses the place utility axis and whether, who and why people have negative place utility.

This section begins by investigating the validity of considering migration as a proxy for dissatisfaction by comparing this variable against a scale against which respondents rated their satisfaction with life in their settlement. The usefulness of this scale is tested by comparing values on the scale with the opinion on the direction of change of quality of life in the settlement. A binomial logistic regression to predict negative place utility, based on a series of variables that represent different facets of wellbeing. The final section looks at the reasons why individuals became dissatisfied with their location.

4.2.1 Identifying members of the population with negative place utility

Considering migration can be used as a proxy measure for negative place utility and residential dissatisfaction. When plotting the score on the satisfaction scale against whether a person had considered migration in their most recent period in the settlement; those who had considered migration are less likely to rank themselves highly on the satisfaction scale. Those people that had not thought about migration were more likely to provide the top two values on the scale (see lower panel of Figure 4.1). This supports the use of initiating the migration decision as a proxy for dissatisfaction, as per Speare (1974).

The efficacy of the satisfaction score was tested by mapping it against whether the respondent thought that life in the village had improved, worsened or stayed the same. People who ranked themselves highly on the satisfaction scale were more likely to perceive life in the village as

improving. Respondents who viewed quality of life in the village as unchanged or worsening were less likely to rank their satisfaction high on the scale (see upper panel of Figure 4.1).

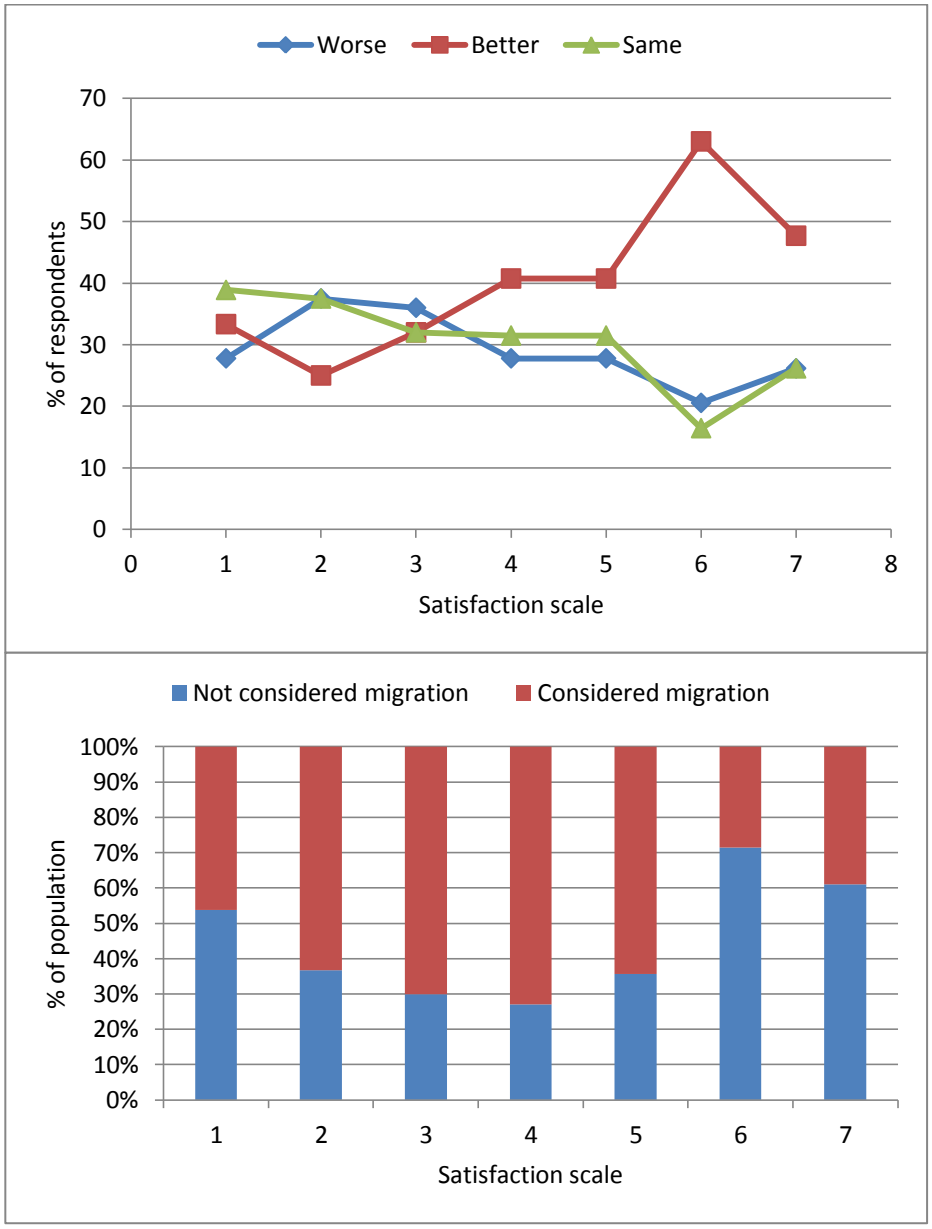

Figure 4.2: Level of satisfaction plotted against view on changes of quality of life in the village, showing consistency between the two measures of satisfaction. Respondents who viewed quality of life in the village as unchanged or worsening were less likely to rank their satisfaction high on the scale. People who had considered migration were more likely to give low values on the scale, while people who had considered migration were more likely to provide the top two values on the scale.

The satisfaction scale is consistent with another measure of satisfaction with location. People who have placed themselves higher on the satisfaction scale are less likely to have considered migration, supporting the use of this question as a way of determining levels of satisfaction. However, the measure is not watertight, reflecting the different ways that the population is using migration in different ways from those originally theorized in models created to understand residential choice in an intra-urban setting.

Satisfied that Speare's (1974) measure of satisfaction holds in the research area, a statement can be made about the proportion of the population whose utility is positive or negative. Based on the proxy of having considered migration, forty-six per cent of the population have a positive place utility. Therefore, this first part of the analysis shows that predictions made by behavioural migration theory apply in the survey population and there are both satisfied and dissatisfied members of a population. Approximately half the population are in the location because they chose to be. The other half of the population would prefer migration to remaining in location; theory would suggest they remain in location because of low mobility potential or insurmountable barriers to migration. The next section investigates whether place utility is a function of the usual predictors of wellbeing, mobility or income.

4.2.2 Predicting negative place utility

In order to find out what groups of people were more likely to be dissatisfied a binomial logistic regression was run using variables known to affect satisfaction and wellbeing. Table 4.1 describes the variables included in the model, the reason for inclusion and the expected effect the relationships between variables will have on satisfaction. Table 4.2 presents the results of the regression.

Variable	Reason for inclusion
Age	Age is one of the most consistent predictors of mobility. One would expect young people to be more dissatisfied because they are more mobile and more likely to want to access the opportunities in other locations.
Education	Similar to the reasons for age, the more educated a person is the less likely the settlement is to meet their employment expectations.
Number of years living stably in the village	The more years a person is stable the more likely they are to be satisfied as they build up a social network and attachment to place. Alternatively, the longer a person has been stable the more likely they are to have considered migration at some point.
Person currently works away	This would be significant not because of dissatisfaction but because of mobility. A person who is currently employed away will by default have thought about migration.
Presence of children in Lima	Children in Lima shows there is a pull factor in Lima that might create dissatisfaction in the respondent. It represents migrant networks; people who can send their children to Lima tend to have relatives to receive them.
Gender	Females exhibit different migration patterns to men, for example related to marriage or gendered household roles or gendered migration flows.
Farmer as livelihood	Farmers are subject to different climate and market forces than people with off-farm sources of income.
Presence of minors in the household	The presence of minors is likely to increase dissatisfaction as a person aspires to send their outside the settlement for a better and/or further education.
Dependency ratio as a indicator of wealth	A person would be expected to be more satisfied with the a lower dependency ratio since there would be less financial pressure on the household

Table 4.1: Justification of variables included in the logistic regression to predict dissatisfaction, and expected impact on satisfaction. Variables used represented age, education, residential stability, current use of mobility, migrant networks, gender, farming as a livelihood, presence of minors in the household and wealth.

Four variables are significant to the 95 per cent level: age, education, the respondent currently access work in other labour markets and farming income source. Every year of age made a person 2.4 per cent less likely to have considered migration. While not to be taken literally, this result shows that older people were not more likely to have considered migration simply because they had been alive longer. The probability of having considered migration increased by 26 per cent with every phase of education completed; by 272 per cent higher if someone in the household was currently accessing employment outside of the village; and by 64 per cent if the respondent was a farmer. Gender is significant at the 95 per cent level but with unreliable confidence intervals, so the relationship between gender and satisfaction could be both positive and negative.

Time living in location was not a significant predictor of dissatisfaction showing that an immigrant to the village six months ago is no more likely to be dissatisfied than someone who has lived in the village their whole life. Having children in Lima was not a significant predictor of dissatisfaction; that could indicate that the situation of having families divided was accepted and that firsthand knowledge of the way of life in Lima did not increase dissatisfaction with quality of life in the rural

settlements. Having minors in the household was not a significant predictor of dissatisfaction demonstrating that although education of children is an important driver of dissatisfaction (see analysis in the following section) it is not a priority for all families with children. Alternatively, it could be reflecting the multiple-family households that exist and that the minors in the household are not part of the immediate family of the respondent.

Dependency ratio is included as a proxy for income and showed that income does not have a significant effect on satisfaction. This is contrary to other measures of wellbeing, for example The Economist Intelligence Unit's quality-of-life index, which rank material wealth as the most important contributor to wellbeing up to a certain income level. Relationships between satisfaction and other indicators of material wealth such as quality of housing materials or job type support this finding.

Variables	**Odds ratios (EXP(B) values)**	**95.0% C.I.for EXP(B)**	
		Lower	**Upper**
Age	0.976**	0.957	0.996
Edu	1.261**	1.091	1.457
Time_stable	0.999	0.986	1.012
EMPLOYED_AWAY(1)	2.718**	1.312	5.631
Children_Lima	1.017	0.866	1.194
Sex(1)	1.508*	0.956	2.379
Farmers(1)	1.636**	1.045	2.562
MINORS(1)	1.005	0.558	1.810
DEPENDENCY_RATIO	0.865	0.368	2.035
Constant	1.049		

Significance levels: *p<0.10; **p<0.05; ***p<0.01; ****p<0.0001.

Table 4.2: Odds ratios for variables expected to have an impact on satisfaction (n=418). Age, currently engaging in employment outside the village, and farming as an income source are significant predictors of dissatisfaction at the 0.05 significance level. The probability of having considered migration increased by 26 per cent with every phase of education completed, by 272 per cent if someone in the household was currently accessing employment outside of the village and by 64 per cent if the respondent was a farmer.

Respondents who are currently gaining income through a strategy of working temporary contracts in locations outside the settlements were unsurprisingly more likely to have considered migration. Here having considered migration actually is representing a positive place utility or barrier to migration because the household is choosing to keep their base in the settlement and access job markets elsewhere, instead of moving the whole family elsewhere.

Farmers and the young and educated represent two different quadrants in the mobility versus place utility space. The young and educated are, at the outset, the most mobile section of the population. This group has a negative place utility and high mobility and therefore would be

expected to have acted upon their dissatisfaction through migration. It is likely therefore that this group remains in place due to barriers to migration, or a low intrinsic mobility *potential*.

According to this model, farmers have the highest average age, lowest levels of education and the longest periods of residence in the village and therefore they are one of the immobile groups of the population. They represent a group whose low mobility forces them to raise stress thresholds in response to stress. The young and educated may eventually overcome their socio-psychological barriers if dissatisfaction was great enough; the farmers do not have the same mobility and are unlikely to ever act on their dissatisfaction.

The conclusion that can be drawn from this regression analysis is that residential satisfaction is not correlated with wealth, and that something other than wealth is keeping people in location and merits further investigation. However, even this result must be treated with care since the model does not control for all possible confounding variables and is not fully robsut. Hence, the model was used to shed light on some relationships that can be investigated more thoroughly using other methods in the remainder of the chapter

Section 4.2 investigates the interaction between place utility, mobility (relating to age and education) and mobility potential (relating to an intrinsic reluctance or openness to migration). First, however, section 4.2.3 explores drivers of dissatisfaction in the survey population, since traditional predictors of dissatisfaction, such as low income, did not emerge as significant in the regression model.

4.2.3 Drivers of negative place utility

If the respondents had considered migrating from the village, he or she was asked why. The answers were coded, and similar responses were clustered. The drivers of dissatisfaction that emerged are in agreement with widely accepted, self-reported drivers of migration: work, a lack of education opportunities and possibilities, life-cycle stages and seeking change and adventure. Work reasons related to both an absolute shortage of work and a desire to improve income.

Table 4.3 provides empirical examples from survey responses and the proportion of responses that fit into each category. A lack of resources represents a financial barrier to migration, physical immobility also acts a barrier to migration. Social ties represent low mobility potential, search and evaluation has leads to a reassessment of the decision to migrate. Some people are still in the decision-making process, a large proportion is dissatisfied because of the knowledge that the village will not meet their needs in the future. Obligations can represent household constraints on the individual's decision-making or low mobility potential.

Driver group	%	Examples
To build a better future for their family and themselves	43	• When my son finishes school I've got to leave to look after him (221) • To know or achieve something better (290) • For the betterment of my children, so that they can be something in life and not stay here like me (302) • For the betterment of my son and myself (341)
Lack of income: no work, a lack of business or a bad harvest	18	• For a job, because there are no jobs here (297) • Sometimes here there's no income (275) • There were diseases in the farm, additional spending (353) • For lack of money, to work (419)
Life-cycle stages : family formation, unification and separation; retirement and health	15	• To live with my daughter and be with her (339) • My husband left me (26) • I would like to leave because of my age and recover my health (185) • I had had problems here with my family (264) • When I am not able to work in the chacra anymore (289) • To go back to my village (13) • Because my daughter went to study to Lima and I thought that something bad could happen to her (158)
Desire to improve income	9	• I always think that life in other countries is better (73) • I think about working in another place to earn better and support my children. Here they pay you little money and it's not enough (219) • To have a better income for my family (41) • To start a business in Lima (204) • Go where there's more business (146) • I've only got only day labour here and in Huancayo I could start a business in my dad's house (412) • To do business, grow rice and peanuts in the jungle (320) • For business, there's no business here (284)
Looking for a change or an adventure	8	• For the adventure, to take the risk (283) • To live in another place soon (239) • Because I want to see other places (335) • Too much corruption (139) • Because I was young, looking for fun (287)
Miscellaneous	2	• Because of the climate, it's cold here (389) • I am going to Chosica because of my girlfriend (165)

Table 4.3: Classification of drivers of dissatisfaction showing the different economic and non-economic reasons that cause residential dissatisfaction in the survey population and initiate the migration decision-making process (n=233). Drivers of dissatisfaction are consistent with common drivers of migration: work, a lack of education opportunities and possibilities, life-cycle stages and seeking change and adventure. Work reasons related to both an absolute shortage of work and a desire to improve income.

Drivers of dissatisfaction are both economic and non-economic. Economic drivers relate to a lack of work, and to a desire to improve income sources. Eighteen per cent of the dissatisfied population had considered migration due to a lack of work. Most common in this group was considering migration because of work (11%) or due to lack of work (3%). A few mentioned people had considered migration due to a bad harvest (1%) or due to a lack of business (2%). Nine percent of the dissatisfied population had experienced dissatisfaction because they felt that their income could be better elsewhere. They had considered migration to find a better job (4%), work

abroad (3%), start a business (1%) or be in a place where there was more business (1%). One person mentioned wanting to farm elsewhere in the jungle where it would be more profitable.

Non-economic drivers of dissatisfaction related to: the lack of opportunities and possibilities for education and a better future in the village; life-cycle stages and being with family members; and seeking a change or adventure. Dissatisfaction generated by a lack of opportunities in the village counted for 43 per cent of the total. Migration to access better education opportunities for children was mentioned most commonly (26%), followed by seeking a better future in general (7%). Lack of education in the village was the most common source of dissatisfaction. Six per cent of people had considered migration to secure a better future for their children, 2 per cent wanted to better themselves or access education (2%).

Another non-economic group of drivers related to life cycle stages, such as separation from a partner (1%), retirement (2%) or due to poor health (1%). Most common in this group was a dissatisfaction generated by not being with family members (especially children) in Lima. This represented five per cent of responses. Two per cent had considered migration because they wanted to go back to their home village, another one percent because their husband or wife wanted to leave or was already living away and another one per cent to build a house elsewhere.

The final significant group of drivers for migration relates to a general dissatisfaction with life in the village, a desire to see other places and seeking change in general. Three per cent of the dissatisfied population mentioned looking for a change, two per cent stated that there were no positive aspects of life in the village; two percent were looking for adventure and to get to know other places. Three people (1%of the respondents) had considered migration to live in a place with a better climate, one person talked about leaving to find an easier way to earn money than working in the mines, and 13 people gave no reason for having considered migration.

With respect to dissatisfaction, a distinction exists between those that had considered migration because they were lacking an income source and needed a way to make a living, and those that had considered migration in order to access better income earning opportunities. The people who were dissatisfied because of a lack of work were not necessarily experiencing residential dissatisfaction; those that were looking for better employment options were.

Eight per cent of the population had no particular driver for migration, other than to explore, see new places and get out away from where they had always been. This kind of adventure migration shows the wild-card nature of migration drivers, as well as the intrinsic mobility potential of this group. Following the ideas of behavioural migration theory, this group has a high mobility potential due to their enthusiasm for exploring opportunities outside the village. This is opposite of the idea of ‘rootedness’ and a lack of interest in the outside world. Those that would like to

improve their income is another group that could be classified as having a high mobility potential, but are held back by other kinds of place utility and barriers from acting on this mobility.

4.3 Profiling mobility

This section investigates the mobility axis of the mobility/place utility space. The analysis defines two kinds of mobility: mobility based related to demographic factors, namely age and education, and intrinsic or psychological mobility *potential*. In behavioural migration theory, the latter dictates the stress threshold level of the individual and the level of negative place utility that they are willing to withstand before migration. The analysis makes use of the former as an objective measure of whether a person will be able to act upon the dissatisfaction they experience. A mobile person may overcome psychological barriers to migration if the stress he or she experiences is sufficient.

This section develops findings from the previous section with regard to the interaction between mobility, place utility and barriers. It starts by looking at the barriers to migration in the low place utility portion of the population and uses responses to identify social and resource barriers to migration, as a well as people who show characteristics of low mobility potential. This allows the chapter to draw conclusions as to whether high mobility potential, low place utility members of the population remain in location because of resource barriers to migration. The section then investigates the linkages between low demographic mobility and low mobility potential with respect to the dissatisfied portion of the population and the potential for this group to cross their stress threshold and migrate.

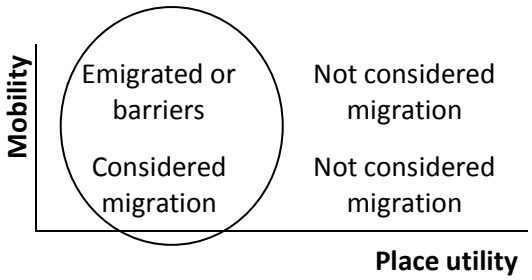

Figure 4.3: Place utility/mobility categorizations in the population. Section 4.3 addresses the mobility axis of this space and the differences between low and high mobility dissatisfied members of the population.

4.3.1 Barriers to migration, leaving the migration decision-making process and low mobility potential

This section analyses the reasons why people had stayed after they had considered migration in the context of the migration decision-making process. Barriers are self-defined and represent the barrier that prevented migration from occurring in response to a particular dissatisfaction

experienced (discussed in Section 4.2.3) and not in general. That is to say, the barrier mentioned might still not be a barrier to them.

Behavioural migration theory focuses on the migration decision-making process. Considering migration is only an indication of residential dissatisfaction, which is a state in which someone can exist until he or she reaches a personal stress threshold. People may come out of the migration decision-making process and raise stress thresholds or make an adjustment in location to reduce stress as opposed to moving location. People can come out of the decision-making process due to a low mobility potential, due to a positive reassessment of their current situation on consideration of alternative locations and due to barriers (social, financial and physical). All these reasons for leaving the migration decision are present in the reasons for staying in location after experiencing dissatisfaction. Table 4.4 presents these reasons coded and clustered into nine groups with empirical examples: insufficient resources; obligations to family or property; children still in school; social and emotional attachment to place; negative outcome of search and evaluation stage; the driver of migration was removed; physical immobility and yet to adjust stress thresholds.

The interplay between place utility and mobility potential can be seen as people have experienced dissatisfaction but are scared to go, unwilling to leave family members or their house or farm. Although dissatisfied, the reluctance to leave is greater than the dissatisfaction that they are experiencing and so stress thresholds have been raised. Six per cent of respondents had considered alternative locations and readjusted their stress thresholds accordingly. Barriers include physical immobility related to age and a lack of resources, stable work or residence at the destination location, as well as obligations to family members. Four per cent of respondents were yet to leave the migration decision-making process stating that they were waiting for the right opportunity to present itself. A final group has considered leaving the village to access education opportunities when their children; it is a future need that will not be met. 3 % of respondents did not provide a reason.

Reason for staying	%	Examples
Insufficient resources: lack of property or stable work in another location or the funds to move	26	• I don't have a house, nor work [in Lima], that's why I don't go (175) • Lack of money, everything is money in Lima, and if you don't have a property you've got to pay to rent a place (213) • We don't have enough money yet to buy a house in another place (210) • I haven't got the land to build a house to live in (34) • I haven't got enough money and I can't find stable job (304)
Obligations to family members or property/assets: can represent a reluctance to migrate	23	• Because of my mum, I've got to look after her (168) • Because of my mum, she can't get used to it in other places (228) • So that I don't have to leave behind my wife and children (134) • I've got my house here, if I'd gone how could my other son stay on his own? It would be too expensive to take him to Lima too (158) • There isn't anybody to leave my children with, there is no replacement for a mother (219) • There isn't anybody to leave my animals and my house with (217) • My wife doesn't want to leave this place, she wants to be close to her family. She's from Huarochirí (412) • Because Hector doesn't have the courage He wants to spend his whole life at his mum´s side (24)
Children are still in school: dissatisfaction relates to a future requirement	18	• I don´t go away because of my land (365) • Because of my business (201) • Because of my job, there´s mining here but in other places there aren't any jobs (434) • Because of my husband´s job. There´s no mine in Huancayo (434) • My daughter´s job and my granddaughter´s studies (115) • They [my children] are still studying at secondary school. When they graduate... (441) • They're still studying, they'll finish and they're off, if not they don't have a future(246) • I'm waiting for my son to finish school (335)
Social ties: affective and psychological ties to the location	11	• So as not to leave my parents, I miss them (30) • For fear and being afraid to go alone (297) • There are lots of memories of our mum here (398) • You would never get used to it in another place (439) • I'm afraid that people will steal my things [while I'm away] • Due to lack of decision, I still haven't decided (351) • I stayed because...I couldn't tell you...I didn't feel...it's hard to leave on your own (275)
Alternative worse: negative outcome of a cost-benefit analysis of moving	6	• I'd got used to San Mateo (425) • I think it'd be the same or worse somewhere else (152) • Lots of bad things happen in other places, kidnappings, they even kill for 10 soles (126)
Needs changed and driver disappeared	6	• They're offering me work here now, so I stay (155) • I started to work here and changed my mind. Perhaps in the future (327) • In the end my husband came here and we're doing more or less okay (114)
Lack of opportunity: yet to adjust stress threshold and come out of migration decision	4	• They got married [his children] really quickly and left (118) • I haven't had the opportunity yet (27) • I don't know where to go yet, yes, I'm thinking (65)
Physical immobility	2	• I already told you, because of my health (124) • She's pregnant (19) • I'm old now, I've got a life here (300)

"About to go"- migration planned	2	• As soon as I sell my farm, I'm off (336) • I'm waiting for my son to finish school this year and then we're leaving (417) • No, in two or three years I'm leaving, I'm going to miss my village, but that's life (345)
Not driven	<1	• I didn't feel like leaving (10)

Table 4.4: Reasons why respondents did not leave after having experienced dissatisfaction (n=233). Barriers to migration related to insufficient resources; obligations to family or property; children still being in school; social and emotional attachment to place and physical immobility. Others did not migrate because of a negative outcome of the search and evaluation stage; because the driver of migration no longer existed; or because they were yet to adjust stress thresholds. The reasons for not migrating can be mapped against the different phases of the decision-making process illustrated in Figure. 2.2.

Twenty-six per cent of dissatisfied people cited financial barriers to migration – a lack of a house in Lima, a stable job in Lima or lack of resources to move there. Two per cent of the dissatisfied population spoke of physical barriers to migration – advanced age, ill health or falling pregnant. Twenty-three per cent of the population gave obligations in the village as reasons for not acting on their dissatisfaction. A stable job, a spouse that wanted to stay in the village, a mother that needed to be cared for or a house or farm that required their presence were obligations that tied them to the village. Eighteen per cent had not migrated once experiencing dissatisfaction because the driver of dissatisfaction was something for the future. People with children realized that if they wanted their children to have further education they would have to move to Lima. However, whether this dissatisfaction will translate into migration is unknown since children move to Lima without their parents, often the oldest. A mother will often hope to move down once the youngest of her children has left secondary school.

Eleven per cent of the dissatisfied population decided not to leave after having considered migration because of socio-psychological ties to their family and to life in the village. For six per cent of the population the driver of migration had disappeared, the children would have required education in Lima started their own families in the village, or people that were thinking of moving because of work but found work in the village. Four percent of the population have felt dissatisfaction but have not left the migration decision-making process. This group is yet to adjust their thresholds, make a conscious decision to stay, and leave the decision-making process. They are waiting for an opportunity to arise or there is lack of decision on leaving. In reality, psychological, social or financial barriers are preventing these people from leaving, but they are yet to acknowledge this and readjust their stress thresholds. Two per cent of the population stated that they were currently in the process of leaving.

Six per cent of the dissatisfied population can be identified as having left the migration decision-making process at the search and evaluation phase. This group has remained in place because they have realized that alternatives are no better than where they are now. Much of the uncertainty that usually faces potential migrants is removed since Lima is already in their *activity*

space, as well as in their *direct contact space* (Quigley and Weinberg 1977). That is not to say that people do not have irrational views on life in Lima, gained from television news reporting. Crime, added to by a high cost of living, means that life in Lima is more constrained and less flexible. Many people may have actually tried to live in Lima for a period and have firsthand experience of life in Lima and have returned because they were not able to settle there.

The analysis above has revealed the different reasons why people left the migration decision-making process in accordance with the different phases of the decision-making process as explained by behavioural migration theory and presented in Figure 2.2. Obstacles to migration can be both physical, relating to insufficient resources and social relating to obligations to family and assets and psychological a fear of going leaving and affective attachment to place. Those that have left the migration decision-making process at the search and evaluation stage have returned to a state of positive place utility on assessment of the alternatives.

A large proportion of the population is in a state of dissatisfaction because of a future need that the village is unable to meet, namely education for their children. These people, although not currently dissatisfied, have lost a future commitment to the village since it does not allow them to fulfil their aspirations for themselves or their family.

Although resource and physical barriers to migration are important, representing 28 per cent of the reasons for remaining in location, the interactions and trade-offs between negative place utility and mobility potential are important in preventing migration. People trade off-between different aspects of their wellbeing, for example, the desire to improve some aspect of their life, but yet reluctant to leave their stable job. This highlights the difference between this work and that of Speare, in that Speare (1974) focuses on satisfaction with housing and location, whereas this research encompasses wellbeing in general.

The reasons provided by respondents for not migrating reveal people's innate low mobility potential. Respondents gave barriers for migration that have not stopped other residents from leaving. A barrier for one person is not necessarily a barrier for another with a higher mobility potential. Migration to Lima is possible without a house or job there, and many families live in different locations in order that family members can access different services provided in different locations. However, this research has to take the respondents at face value and classifies these reasons for not leaving as financial barriers.

There are various aspects of the place in which people live that were both represented as positive and negative pulls depending on the person. Social connections can be both positive (representing a desire to be close to family) or negative (representing an obligation to look after family members). Ownership of a house is both a positive and negative reason to stay. Some view

the house as a liability if left unattended. Others see ownership of property as a positive financial motivator to stay since leaving would require paying rent. Whether positive or negative with respect to how the respondent views the barrier, these attachments can be interpreted as reflecting a low mobility of the respondent since they are not immutable. One would expect the population to be of a low mobility potential because of its place in the sending area of a well-established migration system. Some members of the population self-reported a low mobility potential, in the form of their own reluctance to leave.

The next section puts the responses in the context of an objective measure of mobility to make some statement on the potential for the population to overcome barriers or their own low mobility potential in a situation of lowered place utility.

4.3.2 Demographic indicators of mobility

The aim of this section is to investigate how mobility potential and demographic predictors of mobility interact, and how mobility potential and place utility. Behavioural migration theory conceptualises mobility potential and place utility as two sides of the same coin: someone with a higher place utility is likely to be more reluctant to leave. Age and education are two of the most universal predictors of mobility (White and Lindstrom 2005) and so are used as a proxy for 'demographic' mobility (as opposed to mobility potential). People under the age of thirty and with secondary education were coded as high mobility; over 30 and with only primary education were coded as low mobility.

In order to obtain a quantitative measure of low mobility potential, data on barriers to migration were re-coded into a dummy variable. Responses that reflected a reluctance to migrate rather than a real barrier to migration were coded as revealing low mobility potential. The responses fitted into three groups: those that demonstrated an affective attachment to place; those that related to fear of, or disinterest in, alternative locations and obligations to homes, houses and farms. The sub-codes chosen to represent low mobility potential were: reluctance to leave mum, scared to go alone, used to it in the village, lack of decision, lack of opportunity, family, unable to leave house unattended, unable to leave chacra unattended, considers it to be worse elsewhere, too much crime elsewhere, person feels that they are fine where they are.

The low mobility potential variable was cross-tabulated with the variable that represented demographic mobility potential. These two variables were cross-tabulated with farming as an income source, since farmers were associated with negative place utility in the previous analysis. Table 4.5 shows the results of these comparisons.

	Low mobility potential	Young & educated	Farmers
Farmers	46%*	22%	---
Non-farmers	22%	14	
Under 30 w/secondary education	31%	---	
Over 30 w/no secondary education	30%		

Table 4.5: Testing the relationships between demographic and behavioural predictors of mobility and between predictors of mobility and farmers as a group more likely to have a negative place utility (n =225,*indicates a significant chi-square test). Demographic mobility and mobility potential are not related, farmers are no more likely to show low demographic mobility, but are more likely than the rest of the population to exhibit characteristics of low mobility potential.

The relationship between demographic mobility related to age and education and behavioural mobility potential is not significant, showing that the two measures are unrelated and a young, educated person is no less likely to feel a reluctance to leave than a person with less capacity to migrate. The relationship between farmers and demographic mobility is also not significant, showing that farmers are no less able to use migration (objectively speaking) than a non - farmer. Finally, the results show that when subjective measures of mobility are taken into account, a farmer is less likely to exhibit mobility characteristics than non - farmers.

In the survey population, farmers were more likely to have experienced dissatisfaction, but they are also more likely not to have acted on that dissatisfaction with migration because of their low mobility potential, most likely related to their attachment and obligations to their animals and farms. However, measured objectively in terms of the proportion of farmers aged less than thirty with secondary education, farmers are no less able to migrate than any other group. What can be concluded from this is that with another external stress applied to the farmers, which results in a fall in utility, this group is likely to raise stress thresholds rather than leave, suffering increasing residential stress.

The young and educated were more likely to have experienced dissatisfaction. However, although they have high objective mobility, they are no less likely to have low mobility potential. Therefore, this group is likely stuck in a situation where they are trading off between different aspects of their utility – although they are dissatisfied because they are able to leave and are cognizant of the opportunities available to them elsewhere, attachment to their village, fear of leaving, and a reluctance to leave their family prevents them from leaving. This is confirmed by cross-tabulating the young and educated group with dummy variable representing resource barriers to migration (insufficient funds, lack of house or stable employment in the destination location). The results of the chi-square are non-significant showing that the young and educated do not remain in location because of financial barriers to migration any more than another group- their intrinsic mobility is wining out over their objective ability to migrate.

4.4 Discussion

This chapter sets out to test three hypotheses generated by behavioural migration theory, namely that the population contains members with both positive and negative place utility and initiating the migration decision-making process represents a move from positive to negative place utility; that high mobility potential and negative place utility members will not be present in the population, but if present will be subject to resource barriers to migration; and that high place utility is a function, in part of the population, of low mobility potential.

The results of the chapter are highly consistent with those that behavioural migration predicts. The population is divided almost evenly between those that have initiated the migration decision-making process and made some implicit cost-benefit analysis that lead them to stay, and those that have not considered migration and assessed the relative gains or losses in utility from migration. Initiating the migration decision-making process reflects dissatisfaction with location, consistent with Speare (Speare 1974). Using the initiation of the migration decision as an indicator of negative place utility, allows the identification of the population with negative place utility and the characteristics most likely to be associated with dissatisfaction. Whether these characteristics are common across populations remains to be seen.

This analysis has extended the idea of place utility and residential satisfaction from Speare's original definition to become more inclusive and more closely related to wellbeing in general. This is because the residential dissatisfaction does not relate to a specific house (and a move to a different house in the same area would release the pressure, say from having not enough space), but to a specific settlement. In this way, the causes of dissatisfaction become much broader. However, on investigation of predictors of negative place utility, measures of material poverty did not emerge as significant. Material wellbeing is generally the most significant predictor of general wellbeing (up to a certain point) (e.g. Narayan, Chambers et al. 1999; Economist Intelligence Unit 2005).

The second hypothesis addresses the high mobility potential and low place utility quadrant of the mobility utility/place utility matrix. Theory predicts that individuals with high mobility potential and low place utility will have already migrated from the settlement. The results support the hypothesis because the predominant barriers to migration are social, which indicates a low mobility potential and an internally imposed barrier to migration. Financial concerns only represented a quarter of the barriers to migration showing that the majority of the individuals with negative place utility and high mobility have found a way to migrate, regardless of financial barriers.

However, is high place utility a function of low mobility potential? Farmers, a group more likely to have negative place utility, are no more likely than non-farmers to have a low mobility, but they

are more likely to demonstrate characteristics of low mobility potential. In this case, low mobility potential has not brought about higher place utility. Stronger sense of place does not accompany a reluctance to leave. Nor is low mobility potential driven by an actual inability to leave – indicators of mobility potential and mobility do not correlate with each other.

4.5 Conclusion

The drivers of dissatisfaction, and therefore, the drivers of migration among the survey population are expected and common, relating to finding and improving income sources, education, life-cycle stages and seeking adventure. The reasons for not using migration to address a state of dissatisfaction are consistent with behavioural migration theory; reasons represent both interactions of place utility with mobility potential, through interactions of dissatisfaction with social barriers to migration, and the further stages of the migration decision (cost benefit analyses of benefits of other locations and barriers). Social and psychological drivers of, and barriers to, migration dominate over resource related drivers and barriers, demonstrating the low mobility potential of the population. This has implications to those wishing to facilitate migration as a response to environmental degradation.

The drivers of dissatisfaction do not provide many entry points for environmental factors to influence the migration decision-making process. That is to say, the drivers of migration are not particularly climate sensitive. Only around a quarter of drivers of dissatisfaction relate to income and are sensitive to a change in agricultural productivity stemming from environmental change. The most common driver of dissatisfaction relates to the lack of provision of education and opportunities to advance in life in the villages. This has graver implications for the future viability of these rural locations than environmental change.

The results presented in this chapter all suggest that satisfaction with location is not purely driven by resource scarcity and that the drivers of negative place utility are not likely to be impacted directly by environmental change. Therefore, the next chapter examines what exactly creates place utility in this population, and whether the factors that contribute to place utility are sensitive to environmental change.

5 The role of ecosystem services in creating place utility

5.1 Introduction

Chapter Four used behavioural migration theory to assess the propensity for migration and whether people were able to respond to a fall in place utility with migration. The results revealed that approximately half the population had negative place utility and that dissatisfaction was not a function of material income. Nor were the barriers that prevented migration predominantly financial but reflected a friction between trade-off within an individual of the different contributors to satisfaction and between personal preferences and social obligation.

However, the results of Chapter Four only relate to the dissatisfied portion of the population. This chapter explores the characteristics of life in the village that create satisfaction. Since drivers and barriers to migration are predominantly social, environmental change can only affect the migration decision-making process through its impact on place utility. Therefore, this chapter focuses on the contribution of ecosystem services to place utility.

This chapter implements the idea of place utility through the concept of sense of place. Sense of place is an overarching term for the ways in which people attach meaning to the location in which they live. Place attachment refers to the affective bonds that a person has with their location whilst place dependence describes instrumental bonds formed through the ability of a place to help a person meet goals and aspirations (Quinn, Lorenzoni et al. 2012 in prep.). This analysis conceptualises place utility as a function of both affective and instrumental bonds to place and examine the role of ecosystem services in creating both these kinds of attachment.

The chapter addresses three hypotheses: rural populations gain a large proportion of their utility from ecosystem services; utility gained from ecosystem services varies among the population and that the kind of utility gained from ecosystem services varies between sub-groups of the population. The survey question “What do you like about life here [in the village]” is used to determine the characteristics of location from which people gain satisfaction. The question “Would you leave if you had the money?” provides information on the strength of place attachment and its role in the migration decision. The population is disaggregated by job type, which is categorised into five groups: salaried employment, informal independent (small business owner), dependent informal, housewife and farmer; and past mobility (non-mover, return migrant, immigrant and return immigrant) of the respondent.

The chapter finds that although never a reason to remain in location, ecosystem services are important in creating affective bonds to place both in the farming and non-farming sections of the population. Use of ecosystem services is not a prerequisite for affective attachment to ecosystem

services and so the impacts of environmental change will be much wider than just the farming population.

The chapter begins by analysing the benefits people gain from location. It continues by mapping those benefits onto different kinds of place attachment to show the different ways in which people form affective bonds to place. The third section analyses the relative strength of the different kinds of place attachment. I then look at the role of ecosystem services in creating instrumental and affective bonds to place and the different kinds of non-provisioning ecosystem services from which people gain utility. The final sections disaggregate benefits gained from location and use of non-provisioning services by sub-groups of the population.

5.2 Place attachment: emotional, identity and health benefits from location

Material wealth does not predict wellbeing, therefore it follows that the population gains utility from non-material aspects of their location. The concepts of sense of place encapsulate the idea of non-material benefits gained from location. In this section, the characteristics that the population likes about their settlement act as a proxy for sense of place. These responses provide a 'shallow' or 'passive' measure of sense of place

The survey respondents were asked the question "What do you like about life here [in the village]". Information was provided by 406 members of the sample, representing 579 data points. Sixty per cent of the population only mentioned one characteristic, or characteristics that were coded into one group; 29 per cent of the population mentioned characteristics from two groups.

5.2.1 Benefits gained from location

Coding of the benefits of location revealed six groups: ecosystem services; neighbours, family and social interactions; the secure and safe environment; employment; quiet nature of village life and amenities and services specific to the village. A further group expressed satisfaction with everything in their location.

Table 5.1 provides empirical examples that demonstrate the range of responses within each category. The proportion of the population mentioning ecosystem services is high, reflecting the rural location of these settlements. Respondents mention social factors relatively infrequently, perhaps reflecting low social capital due to the mobility profile of these villages with high levels of emigration, return migration and immigration. Respondents mention work, services and amenities infrequently, since these locations are marginal with respect to work and the support of the state. Safety and tranquillity reflects the small size of the settlement in a rural location and respondents often mentioned it in comparison with Lima.

Category	%	Examples
Ecosystem services	44	• This location is really beautiful (134) • The climate, the pristine environment, the plants, the nature (51) • The climate is a bit milder than in Pacota (12) • It's quiet, I enjoy going to the chacra, going to see how the plants are doing (242) • Everything in Surco is really lovely, especially the scenery (379) • Fresh air is good for your health • The environment is clean and fresh, in Lima you breath smoke and fumes (331) • Lots of water, close to the river, can go and fish, head to the countryside, clean environment (200)
Friends, family and social events	15	• We know each other (73) • Neighbours, the people that I like, people here are more easy going (167) • Being close to my son and be able to help him with his homework (164) • Going to sporting events and village celebrations (253)
Safe/uneventful	14	• The freedom to walk in the streets without worrying that something might happen to you (341) • It's safe, there's no crime (82)
Work related	7	• There are jobs, a better environment for business (118) • There's work in the mine (410) • My job, I earn well (78) • Working, there's lots of work (253) • Being close to work (159)
Services and amenities of the town	7	• The tourist attractions (348) • Houses don't cost a lot (191) • The park, and the old church (275) • The sports stadium (219) • More entertainment, more things to do (11)
Peace and tranquillity	6	• We're close to the capital and can get around easily (398) • The peace and quiet, there isn't anybody making a racket (202) • The tranquillity, the peace (181)
Emotional attachment	6	• Everything, that's why I've stayed (305) • The village and its location, I like everything (99) • My village, I was born here and I'll die here, I'm used to it here (250) • It's my homeland (178)
Miscellaneous	1	• The girls! (280) • It's a place where you can progress, it's got almost everything (274) • The church and Christian people (222)

Table 5.1: Characteristics of location valued by respondents, categorized into seven groups. Respondents mentioned ecosystem services; friends, family and social events; safe/uneventful nature of life in the village; work related; services and amenities of the village; peace and tranquillity and emotional attachment to village, in order of importance. The survey population gain utility from the services, using the term in its broadest sense, that a rural location offers.

Ecosystem services dominated responses. However, since several questions on the environment and environmental change preceded the question on benefits gained from location therefore this may be an artefact of the survey. The ways in which people described the benefits gained from ecosystem services was diverse and not a repeat of topics that had previously been discussed: the natural beauty of the area, the favourable climate, the agricultural lifestyle, the unpolluted environment and clean air, the plentiful supply of water, waterfalls and tourist sites. Furthermore, respondents often valued aspects of the village life in comparison to another location. They

considered the climate warmer and more amenable than in mining villages at higher altitudes; and less polluted and more desirable than in Lima (where the climate is humid, overcast for most of the year and polluted).

No other groups dominated. Fifteen per cent of responses related to social factors: people valued being close to their family, having neighbours who helped each other, annual village festivals and other social events. Fourteen per cent of respondents mentioned the “tranquilo” nature of the village; they valued the uneventful, secure, safe and crime-free nature of the location. A related characteristic is that of peacefulness and calm and the ability to enjoy solitude, mentioned by six per cent of the population.

Only seven per cent of the population mentioned aspects related to work and incomes. This group was diverse in the ways in which people valued work but was in general related to the size of, and access to, the off-farm labour market. Business owners like that there were customers; others appreciated the mining industry and the fact that it had brought jobs to the area. The group ‘Services and amenities’ included infrastructure, social services, cheap house prices and low cost of living (in comparison with Lima) and the location of the village with respect to the capital. Answers of this kind represented seven per cent of the characteristics that people mentioned.

Some respondents stated that they liked everything, highlighting a strong attachment to place. Some people expressed this emotional attachment more strongly, affirming their commitment to the village: “It’s my village, I was born here and here I’ll die”. This kind of response represented six percent of the total.

Although the domination of ecosystem services over other responses is potentially an artefact of the survey design, it highlights that benefit gained from ecosystem services is not limited to provisioning services used by farmers and others directly dependent on natural resources for income. Furthermore, the non-ecosystem services benefits gained from location demonstrate that the population is in general ‘urbanophobic’ (Félonneau 2004) preferring the services and lifestyle that rural locations can offer to those that an urban location can offer.

The analysis proceeds by examining benefits gained from location in the context of emotional attachment to place and investigates the relative strength of different kinds of attachment. The chapter continues by examining the way in which the population gains utility from ecosystem services in more detail.

5.2.2 Benefits gained from location as aspects of attachment to place and the strength of attachment

This section maps the benefits gained from location against the different ways that people form attachment to place, revealing how people form emotional attachment to place in different ways. In order to obtain a measure of the strength of attachment the benefits gained from location are compared with a more active measure of attachment. Active place attachment to place is measured through the question "Would you leave tomorrow if you had the money?" which hypothetically removes the financial barriers to migration. Active place attachment is investigated through the reasons why the satisfied portion of the population responded negatively to this question.

Table 5.2 maps passive (benefits gained from location) and active attachment to place against the different ways in which people form attachment to place, as classified by Fresque-Baxter and Armitage (2012). The kinds of attachment to place which prevent people from leaving are predominantly social factors relating to social connections and sense of belonging. Environmental skills (being competent in managing and operating in one's environment) and meeting of needs (i.e. already having work) are the other reasons why people chose not to leave. Ecosystem services, although mentioned frequently, are never a reason to stay in a location. However, they are important in creating place utility that leads to commitment to place.

Certain benefits act as both passive and active contributors to place attachment, others are only active forms of place attachment while certain benefits only create passive attachment. Environmental skills and commitment to place were the reasons were active forms of place attachment and prevented migration on removal of financial barriers. Emotional attachment to place; sense of belonging and rootedness (represented through answers such as "acá es mi pueblo"); meeting of needs (in this case interpreted as the need to earn a living) and social connections (both knowing neighbours and the presence of family) appeared are both passive contributors to sense of place and reasons for remaining the village. Security, place preferences, the need for continuity and experiential values arose in responses only as passive contributors.

Aspect of place attachment	Passive contributor	Active contributor
Continuity	Farming lifestyle	
Environmental skills		Used to it Lived a long time there
Meeting of needs	Work related services	Work related
Sense of belonging	Emotional attachment	"This is my village"
Social connections	Friends family and social events	Knows everyone; Mum/kids/family there
Aesthetic /experiential values	Climate Lack of pollution Aesthetic value of ecosystems Peace and tranquillity	
Commitment to place		Invest here Buy/build house Save Money not enough of a reason to leave Better here than somewhere else
Place preferences	Services and amenities of the town	
Security	Safe/uneventful	

Table 5.2: Passive and active contributors to place utility mapped against Fresque-Baxter and Armitage's (2012) classification of ways in which people form attachment to place. Survey responses represent seven types of place attachment: continuity; environmental skills; meeting of needs; sense of belonging; social connections; aesthetic/experiential values; commitment to place; place preferences and security.

The need for continuity "the desire to preserve continuity of the self-concept" (Twigger-Ross and Uzzell 1996; 207) was found in farmers who gained utility from the agricultural lifestyle. Living in that location enabled them to maintain their identity as a farmer that would not have been possible elsewhere.

Environmental skills or "the ability to use a specific place to meet the needs and desires of the individual" (Fresque-Baxter and Armitage 2012; 254) were an important reason for not wishing to leave the village. Environmental skills are the competence to act within, and understand and control, the environment in which one is living. This emerges in answers where a person is used to the place in which they live and that they have lived there for a long time. They are comfortable in their location because they are able to use the place effectively to fulfil their own personal goals, elsewhere they would have to exert a lot more effort to achieve the same goals as they learn to understand and manage the place in which they live.

Work aspects mentioned as the things people liked about the village, for example, the fact that their partner had a job or that there was trade for businesses were mapped against the aspect of

place attachment, which is based around meeting of needs, in this case those of paid employment. This was both a passive and active contributor to place attachment.

Emotional attachment to place, through the sense of belonging and rootedness that a place generated as well as the self-esteem that living that place was able to support, was represented through the reply “Acá es mi pueblo” or people that replied that they liked everything. Thinking about their village critically was hard for some people; they had never considered their location in comparison with other potentially places or stopped to think what they might change if they could.

While neighbours, knowing one and another and mutual support were benefits gained from location, family was the dominant reason for not leaving if they had the money. In the survey population, although social interactions had a role to play in creating sense of place they were not strong enough to prevent migration, unless they were social bonds to family.

Security, place preferences and experiential values were three aspects of that could contribute to place attachment that only emerged in the passive likes that people had about their location. Aesthetic and experiential values mentioned as a response to this question include the scenery, nature and the natural environment, the climate and fresh air, as well as the peace and quiet. Place preferences include the place specific characteristics such as amenities, low cost of living and tourist attractions, proximity to work and transport networks. Security was measured through the response of “tranquilo”: people liked that the place was quiet, that crime was low and that a person could walk in the streets without being worried.

Respondents that stated they would invest the money in the village demonstrate a commitment to place. For this portion of the population, the location allows them to meet their expectations and goals and money simply facilitates the process. Responses varied from investing it in the village to buy or build their house and saving the money for the future. Those who said that money not enough of a reason to leave or that life was better in the village than somewhere else also demonstrated commitment to place.

The information contained in Table 5.2 is shown graphically in figure 5.1 and accompanied by percentage of responses that fell into each kind of place attachment for each group (passive or active). The graph plots benefits of location for those respondents who also answered negatively to migration on removal of financial barriers, which equates to 69 per cent of the population.

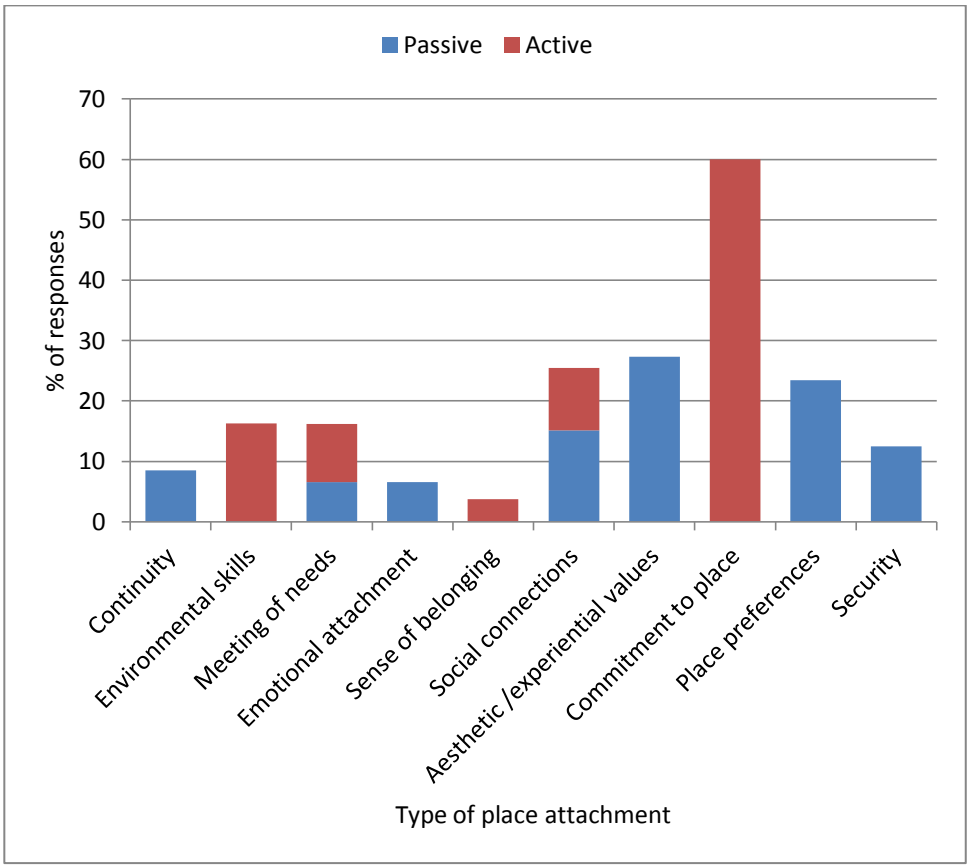

Figure 5.1: The frequency of passive and active contributors to place utility mapped against the ways in which people form attachment to place. The 60 percent of the population that would stay despite removal of financial barriers demonstrates a commitment to place. This means that although attachment to ecosystem services is not strong enough to prevent migration, a loss of ecosystem services may cause a fall in commitment to place.

This part of the analysis has shown that the different benefits gained from location relate to the different ways in which people form emotional attachment to place. Some of the benefits gained from location were also great enough for respondents to state them explicitly as reasons not to migrate, namely sense of belonging and rootedness, meeting of employment needs and social connections. Although ecosystem services did not contribute to any of these kinds of place attachment, they play an important role in creating satisfaction and attachment to place, and therefore, in the sixty percent of respondents that demonstrated a commitment to place, ecosystem services are important in creating the attachment that leads to that commitment.

In the terms of behavioural migration theory, although ecosystem services do not form barriers to migration or lead to low mobility potential, they are important in creating place utility in general, which will then trade off against the former two factors to create or inhibit migration. Having determined that ecosystem services play a role in creating place utility in this location, the following sections investigate variation in the kind of ecosystem services from which people are benefitting and whether and how different sub-groups of the population benefit from them differently.

The proxies to gauge drivers of sense of place are uni-dimensional and simplistic in their approach. Asking people the characteristics the village from which they gain utility only touches upon the complex ways in which people form attachment to where they live. However, previous studies have used such quantitative proxies successfully (see Lewicka 2010) and a uni-variate proxy sense of place allows its incorporation into this wider model of the way people interact with their environment.

5.3 Ecosystem services and their contribution to place utility

Chapter Four found that material wealth did not predict satisfaction. Therefore, the previous section investigated the non-material benefits that the population gains from their location, using the ideas of sense of place. This section is concerned with the contribution of ecosystem services to place utility. It takes a step back and first examines the ways in which people are dependent on ecosystem services for income, that is to say are ecologically place dependent before looking at the degree to which their sense of place that relies on ecosystem services, that is to say the degree to which they are ecologically place attached.

5.3.1 Ecological place dependence – instrumental bonds to ecosystem services

Studies on climate change and migration often assume the farmer to be the sole beneficiary of ecosystem services. A farmer is assumed to gain utility from ecosystems through the provisioning and regulating services that enable agriculture to take place, and the provisioning services provided by agriculture which can be traded for cash and allow the farmer to buy other goods and services he requires.

However, as Figure 5.2 illustrates, there is variation in the degree to which the person and their household depends on farming for an income source. Figure 5.2 plots the predominant income of the household heads against whether the household income is entirely farming related, entirely off-farm or a mix of the two. If the household heads do not farm it was rare for their offspring or other family members to be independently involved in farming. However, household heads involved fully engaged in farming often had offspring with off-farm employment. Farmer household heads were less likely to come from mixed income households – this may reflect the fact that in farming locations offspring must leave the household in order to access off-farm employment. The degree to which children involved in off-farm activities, in the settlement and in other locations, were supporting their parents.

Figure 5.2 shows that across all job groups, there were households that were engaged in farming. Even households with salaried income sources and their own business there were household members that were taking part in farming activities.

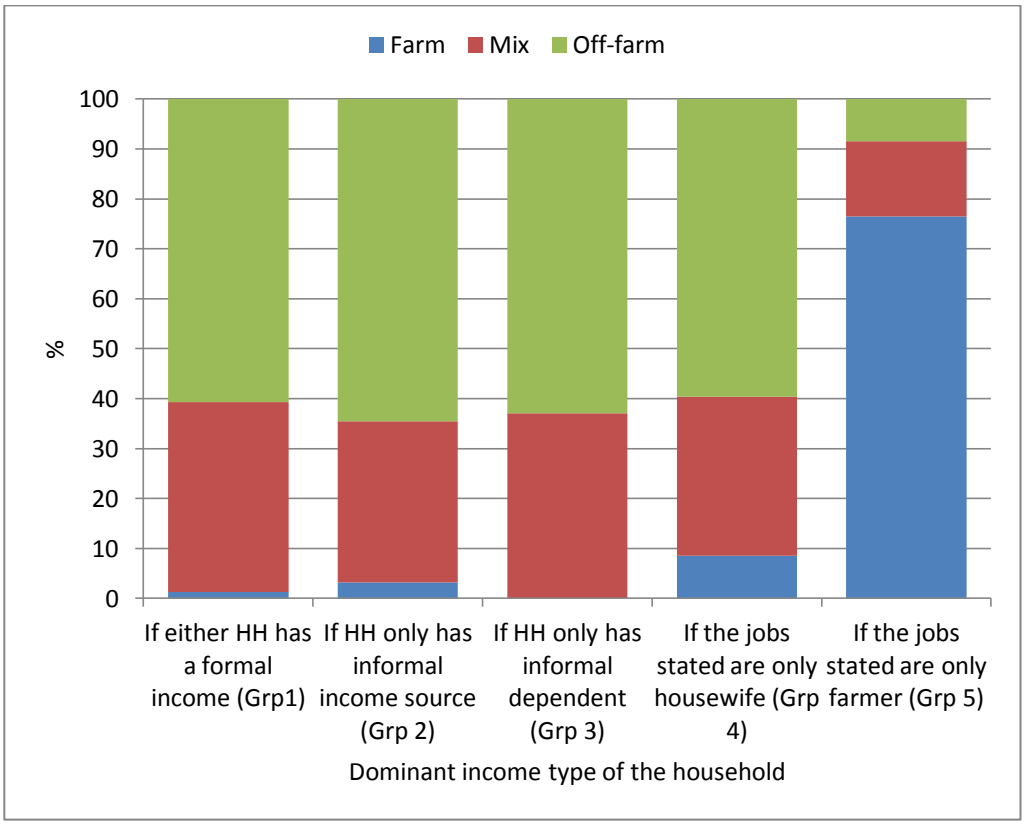

Figure 5.2: Dominant income type of the household heads against household income types. The data show that households that were engaged in farming regardless of stability and level of income type. Even households with salaried income sources and their own business there were household members that were taking part in farming activities.

A farmer does not necessarily have to have access to land in their family; they can work other people's land. Nor do both household heads have to be involved in farming; one might farm while another supplements income with a non-farming income source. Furthermore, there are degrees of freedom that are available to households with respect to income diversification. In a household where there is currently one household head farming with a housewife at home, there is the flexibility for the housewife to look for work if agricultural incomes fall; a single household head engaged in farming does not have this flexibility. Although wage labouring on other people's land is a common in rural areas, among the survey population the percentage of farmers not farming their own land is low. This is perhaps a reflection of the general level of poverty among the farming population with family still the biggest source of labour and few farms requiring additional labour.

Figure 5.3 plots migration history of the respondent against whether the farming-off farm mix of employment in the respondent's household. What the results show clearly is that an immigrant is more likely to come from a household engaged solely in off-farm activities than a person who is from the village, regardless of whether they have left or come back. This reinforces that emigrants keep the rights to their land as a safety net to ensure that they are able to return to the village.

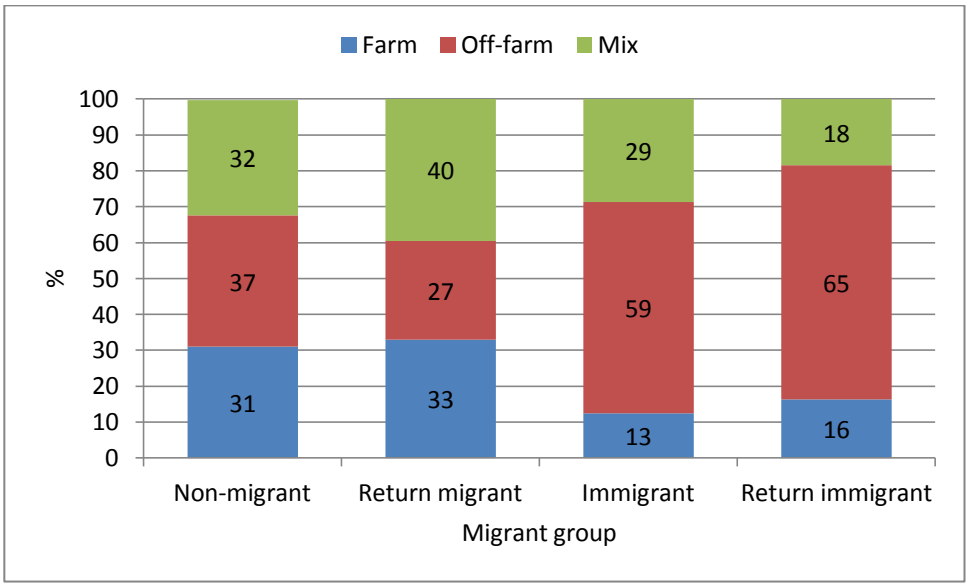

Figure 5.3: Migration history of the individual and ecological place dependence of the household. An immigrant is more likely to come from a household engaged solely in off-farm activities than a person who is from the village, regardless of whether they have left or come back. It also shows that migrants hold onto their land rights when they emigrate in order to be able to come back to them.

Different sub-groups of the population (based on income sources of the household heads or migration history of the respondent) come from households with different degrees of reliance on farming for income. Although there are households that have a salaried income source that also have household members engaged in some way in farming, the relative contribution to income is likely to be less than in households with informal and irregular income sources. Some of the biggest differences with respect to farming were observed between non-movers and return-migrants and immigrants to the location. Institutional barriers affect the ability of immigrants to gain access to land that in turn affects the sensitivity of the instrumental component of their ecological place utility to change. The next section investigates whether these differences hold in the affective aspects of ecological place utility.

5.3.2 Ecological place attachment – affective bonds to ecosystem services

This section looks at the ways in which the survey population benefits from ecosystem services beyond providing an income and how they contribute to creating affective bonds to place. It looks at both responses to the question on benefits of location and more generally of the cultural significance of ecosystem services in the settlements.

Table 5.3 shows a breakdown of the ecosystem service category with empirical examples. The categories are show little internal variation with responses being consistent within them. The survey population most frequently mentioned climate, counting for half of the responses. The remaining fifty percent of responses were spread more or less evenly between the farming lifestyle, lack of pollution and aesthetics of the natural environment. The climate and lack of pollution represent regulating ecosystem services, farming as a lifestyle choice and the aesthetic value of nature represent cultural ecosystem services. Change in ecosystem services will not only affect the population through an impact on provisioning services of agriculture and will have an impact beyond the farming section of the population.

Benefit	**%**	**Ecosystem service**	**Empirical example**
Climate	50	Regulating: Climate regulation	• The climate is a bit milder than in Pacota (12)
Farming lifestyle	18	Cultural: Social relations Sense of place Cultural heritage	• It's quiet, I enjoy going to the chacra, going to see how the plants are doing (242)
Lack of pollution	17	Regulating: Air quality maintenance	• Fresh air is good for your health (387) • The environment is clean and fresh, in Lima you breath smoke and fumes (331)
Aesthetic value	15	Cultural: Aesthetic values Recreation/ecotourism	• Everything in Surco is really lovely, especially the scenery (379) • The climate, the pristine environment, the plants, the nature (51) • Lots of water, close to the river, can go and fish, head to the countryside, clean environment (200)

Table 5.3: Breakdown of ecosystem services category of place attachment. Utility gained from ecosystems fall into four categories: desirable climate; farming as a lifestyle; lack of pollution and aesthetic value of nature in order of importance.

The climate is perceived as a benefit of location because of its positive impact on health (the climate is not humid as in Lima); its desirability for farming (especially combined with irrigation) and desirable with respect to temperature. Respondents perceived farming as a way of life to which they had attachment and from which they formed their identity. Survey respondents

mentioned the lack of pollution often in comparison with Lima while others gained utility from living in locations of outstanding natural beauty, as they perceived it. Table 5.4 provides a summary of the range of cultural services that ecosystems provide in the field area, beyond those directly mentioned in responses on benefits of location and described in Table 5.3.

Activity	**Cultural ecosystem services used**	**Example**
Agriculture as a way of life	• Social relations • Sense of place • Cultural heritage	When asked about what they like about where they live: " Living with my animals in the countryside " (33) " Going to the fields with my animals, raising guinea pigs " (34) " The type of work, the animals " (35) " We all live from the cows, because we milk them, make cheese " (36)
Firewood for cooking	• Cultural heritage	"She can't get used to it, she doesn't want to cook with gas, she prefers to cook with firewood" (35) the field assistant wrote as the reason for her not wanting to leave if she had the money
Token chacra	• Cultural heritage • Educational values	Non-farming households can keep a chacra even though it does not provide much benefit financially, to keep up the tradition and to give the younger generation knowledge of farming practices.
Religious ceremonies tied to harvests	• Spiritual and religious values	Vestiges of pre-Spanish religion structured around the natural world remain in Catholic celebrations. Crosses are placed on surrounding hilltops and brought down and celebrated. In some regions, crosses are put on top of the hills for each of the different irrigation districts.
Natural beauty of the area	• Aesthetic values • Sense of place	"The scenery that takes your mind off things, it's lovely, it relaxes you" (304). "Surco is really nice, I wouldn't change it for anything" (377)
Changes in the natural environment as a source of worry	• Aesthetic values • Cultural heritage • Sense of place	"It makes me sad to see what is happening" (162) when answering how changes in the climate affected her. "I'm actually worried because people don't know how to look after the environment. They cut down trees but don't plant any for the future" (94) when answering how changes in the climate affected him.
People who like being around the farming way of life	• Sense of place	Although they themselves aren't involved in agriculture: " That people grow alfalfa " (136) " The animals in the countryside" (131). Many individuals are the first generation to leave the farming lifestyle.

Table 5.4: Cultural ecosystem services including, and in addition to, cultural attachment to farming and the aesthetics of the natural environment. Maintaining links to a more agricultural past, religious values and worry about changes in the natural environment emerge as important.

5.4 Disaggregation of ecological place attachment

This section investigates the possibility of different groups of the population gaining satisfaction from location in different ways. The analysis disaggregates the population by job type of the individual and migration history of the individual. The aim is to determine which groups are the most ecologically place attached, and whether different groups gain benefit from different kinds of ecosystem services.

Characteristics of the environment and climate dominated responses in all groups. The difference between the farmers and those with informal independent income sources is statistically significant . With respect to other forms of place attachment, differences tend to occur between the farmers and other groups, and not between the off-farm groups, showing that dependence on agriculture for income leads to different patterns of place attachment. Farmers have the lowest appreciation of social aspects of the village while people with a salaried income were most likely to mentioned social aspects. When looking at the differences between the kinds of ecosystem services there is a difference between the farmers and other groups only with respect to valuing the farming lifestyle; otherwise, groups benefit from different types of ecosystem services to the same degree.

Figure 5.4 shows benefits gained from location disaggregated by migrant group. The patterns to emerge from this breakdown are less strong in their signature than those between income groups are. There are no significant differences at the 95 per cent confidence interval with respect with respect to benefit gained from non-provisioning ecosystem services. At the 90 per cent confidence interval, return migrants and immigrants were more likely to mention work related aspects as positive aspects. Return migrants (at the 90% confidence interval) were more likely than immigrants and non-migrants to value the farming lifestyle reflecting both access to land, and the ability to make comparisons with alternative locations.

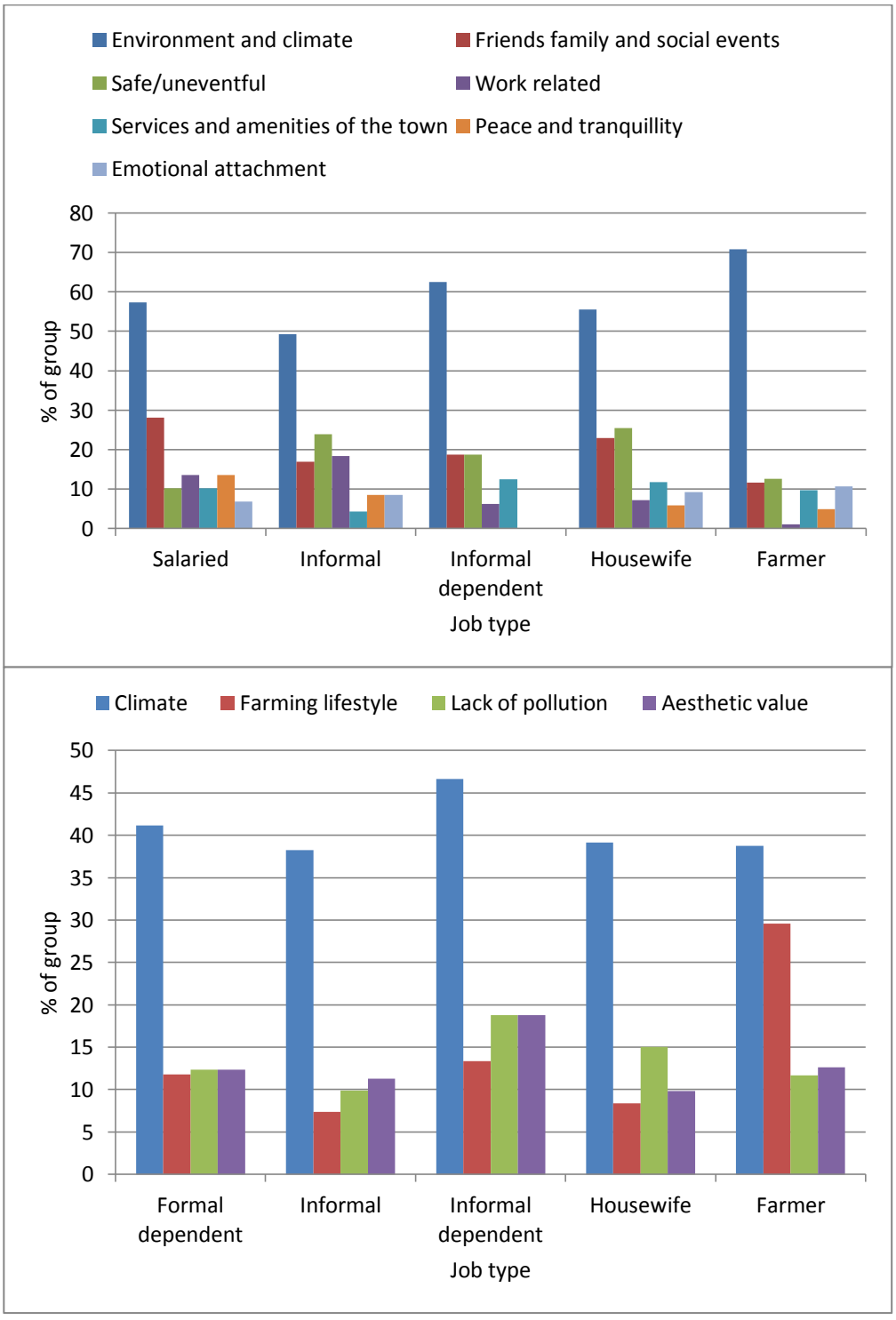

Figure 5.4: Non-provisioning benefits of the settlement and the kind of non-provisioning ecosystem services, disaggregated by job group of the respondent. Farmers could be considered the most ecologically place attached and those with informal income sources (businesses) could be considered the least ecologically place attached with respect to benefit gained from non-provisioning ecosystem services. Farmers are more likely to value the farming lifestyle, but they are not the only group to value the farming lifestyle. Otherwise, there were no significant differences with respect to the kind of ecosystem services from which individuals of different job groups gain benefit.

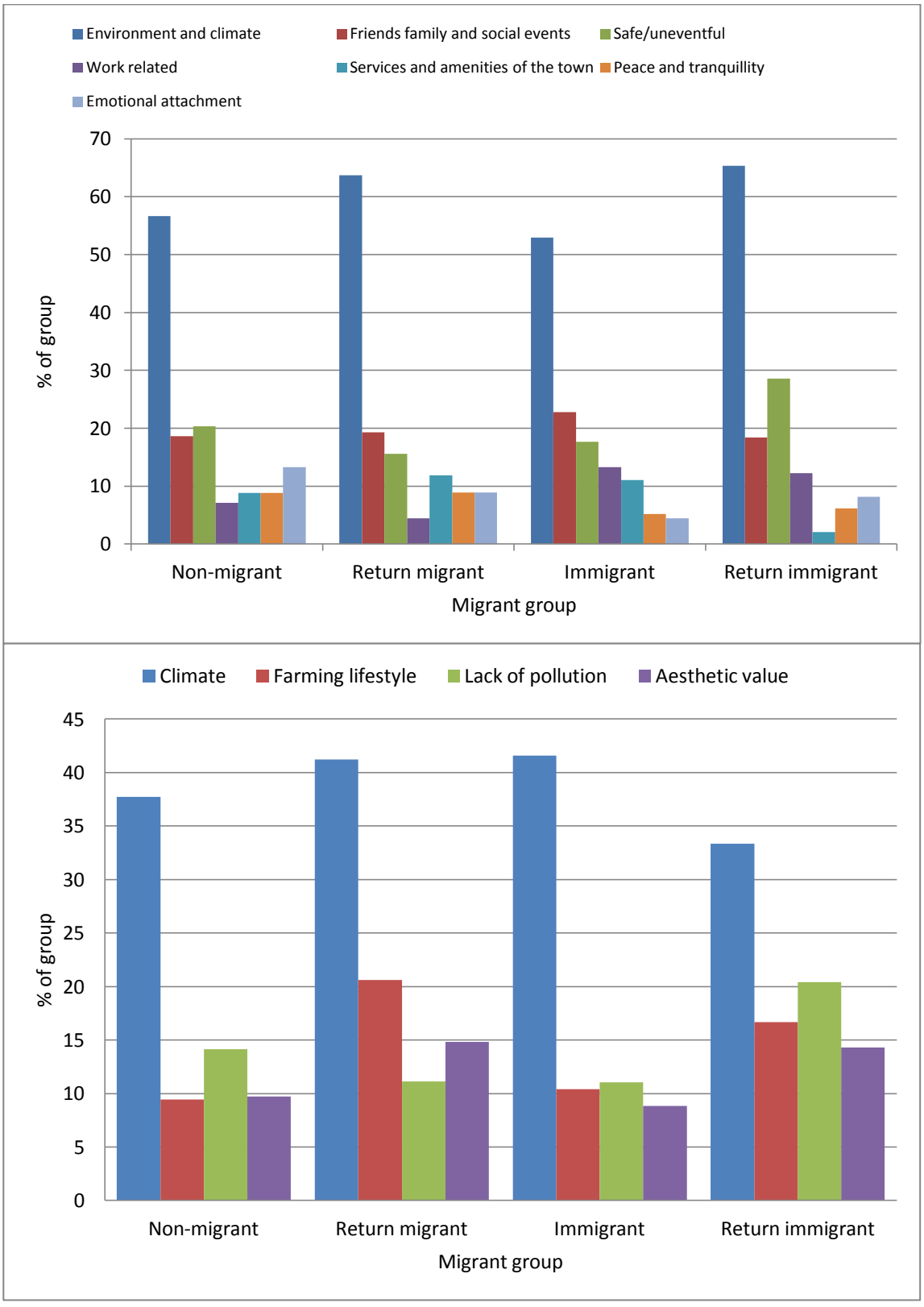

Figure 5.5: Non-provisioning benefits of the settlement and the kind of non-provisioning ecosystem services, disaggregated by migrant group of the respondent. Past migration behaviour does not have an effect on the ways in which people gain utility from their location, nor does it have an effect on the non-provisioning ecosystem services that people value, despite immigrants being less likely to have access to land.

Instrumental use of ecosystem services is not required for other services to be valued. Immigrants are much less likely to be using provisioning ecosystem services as an income source than non-migrants and return immigrants. However, the degree to which individuals gain benefit from ecosystem services beyond their source of income does not vary significantly at all between migrant groups, and with respect to income type, only between farmers (who are the most ecologically place attached) and those with their own income (the least ecologically place attached).

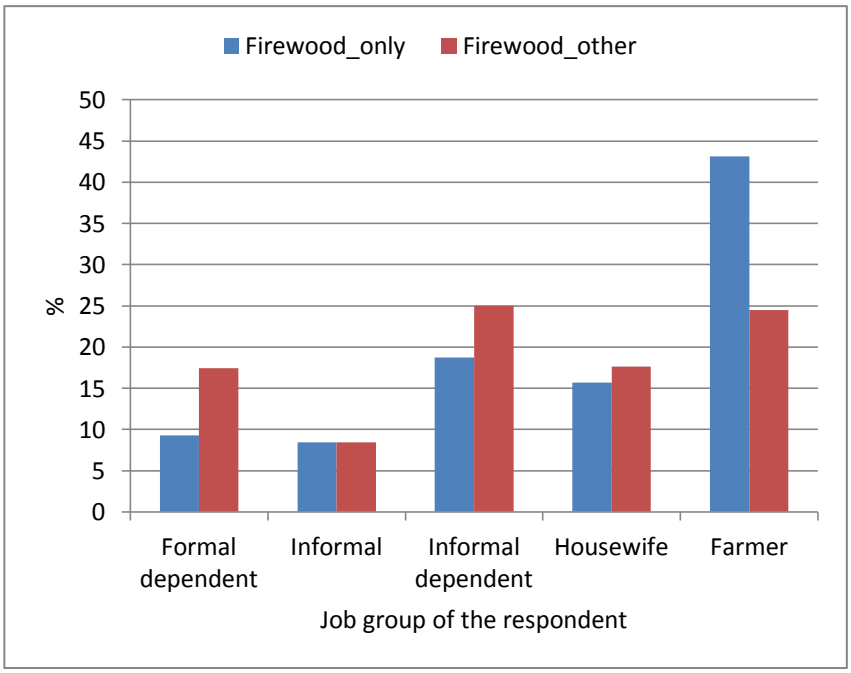

Figure 5.6: Use of firewood by job type of respondent. A proportion of households across all groups use firewood for all or part of their household fuel needs, even in the groups with higher income and financial stability. The fact that firewood use was present by all groups of respondents demonstrates that firewood provides cultural as well as a provisioning services.

The use of firewood as a cooking fuel represents the only example in this research of the direct use of a provisioning ecosystem service; firewood is collected from the countryside by household members. However, use of firewood as a fuel is an indicator of connectedness to ecosystem services, both affectively and instrumentally, and is a reflection of poverty. Firewood use is present in all groups, reflecting the cultural significance of firewood use (see Table 5.4). Farmers were more likely than all other income groups (except the informal dependent group because of low sample size and accompanying high error) to use firewood as fuel. The informal dependent group mentioned firewood as a fuel next most frequently, a reflection of the higher levels of poverty and income instability. The only significant difference in use of firewood is found between farmers and those with an independent income source, supporting the finding that the former group is the most ecologically place attached and the latter group the least. This reflects both that this group is one of the more financially stable while one with the lowest ecological place utility.

5.5 Discussion

The aim of this chapter is to investigate three hypotheses generated by the ecosystems services framework in order to determine the sensitivity of the utility of the population to changes in ecosystem services. The three hypotheses are that rural populations gain a large proportion of their utility from ecosystem services; that the utility gained from ecosystem services varies between sub-groups of the population and the kind of utility gained from ecosystem services varies between sub-groups of the population. The benefits of ecosystem services are broken down into the instrumental benefits from farming as an income source and affective benefits, the non-tangible characteristics of the natural environment to which people form affective attachment.

Benefits of life in the village were coded and clustered into six groups: ecosystem services; neighbours, family and social interactions; the secure and safe environment; quiet nature of village life and amenities and services specific to the village. These characteristics are all those that are traditionally seen as a benefits of small rural locations the world over, except perhaps the benefit of amenities which are generally in short supply in rural areas, but here show sequential migration from yet smaller villages.

The analysis shows that ecosystem services dominate as characteristics of the way of life from which the population gains benefit; ecosystem services are the most frequently mentioned passive contributors to sense of place. However, ecosystem services are insignificant when people trade-off benefits of the village against the benefits of moving elsewhere; ecosystem services do not feature at all as active contributors to place. However, the analysis revealed the 'urbanophobe' nature of the population and its preference for the services that a rural location offers. People demonstrate a commitment to this location and ecosystem services are a key to the rural services it provides.

However, this chapter highlights the need for caution when analysing benefits gained from ecosystem services, and warns against analysing them in isolation. Whether discussing instrumental or affective benefits, ecosystem services will always be important in rural settings. However, their importance to the wellbeing of the individual is of an order of magnitude less than the importance of social factors to creating utility and satisfaction with place. In the survey population, work and economic factors do not drive satisfaction. Therefore, even in farmers, ecosystem services do not drive satisfaction. Despite this, in the environmental migration literature the focus is invariably on farmers and the decrease in benefit they experience from loss of ecosystem services. A loss of income from ecosystem services, even if it creates a loss in income, may not be able to compete with social obligations or wellbeing.

With respect to the second and third hypotheses, the results show that degree to which a sub-group of the population depends on an ecosystem services for utility depends on both the way in which the population is disaggregated and the kind of ecosystem service under question. Income groups and migration groups show different patterns of ecosystem service use and the patterns change depending on the kind of ecosystem services, positively supporting both hypotheses.

Farmers made use of regulating and provisioning services for income and subsistence. The population, both farming and non-farming households, gained utility from regulating and cultural ecosystem services Regulating services mentioned were air quality maintenance that created an unpolluted atmosphere and climate regulation that provided a climate that was desirable for health and for agriculture. Cultural ecosystem services specifically mentioned by the population as providing them with utility were the natural beauty of the area providing aesthetic value, and an emotional attachment and identity formed around the agricultural way of life.

Farmers, although are more likely to have an ecological component to their place attachment than people with a business, are no more likely to have an ecological component to their utility than non-farmers, that is to say people with salaried income, those working for others in an informal manner or housewives. A farmer who only benefits from the natural environment in terms of an income source is likely to react differently to somebody culturally attached to his or her way of life and the natural environment in which he or she works. Equally, not only farmers will have their migration decision-making processes affected by climate change. A third of farmers had no ecological place attachment while just over half of the non-agricultural population gained utility from ecosystem services.

With respect to the hypothesis that the kind of utility gained from ecosystem services varies between sub-groups of the population, the results are less clear. If affective bonds to ecosystem services are further disaggregated, no distinctions are revealed, other than that farmers are more likely than other groups to value the farming lifestyle. However, as the preceding discussion has shown, immigrants were less likely to benefit instrumentally from ecosystem services, but just as likely as any other group to from affective attachment to sense of place demonstrating different ecosystem service use by different groups.

The model does show that there are people who will be affected by changes in ecosystem services that are not directly reliant on them for their income. Changes in ecosystem services will not only affect farmers, although this has been the assumption in many previous studies.

5.6 Conclusion

Different social groups have different access to ecosystem services in the form of land. Yet the results presented here show that instrumental bonds to the natural environment are not a prerequisite for affective bonds to ecosystem services. The implication of this being that the impacts of environmental change on place utility extend will extend far beyond those engaged in farming with implications for modelling migration under environmental change. Past migration studies have tended to focus on the provisioning services that ecosystems provide and not the cultural ecosystem services that are equally important in creating the utility that prevents migration. Equally however, in a rural location change in ecosystem services will not affect everyone since just under a third of the population had no ecological place dependence or attachment.

However, variation does exist between groups with respect to the ecological component of place utility; farmers and business owners were the most and least ecologically attached respectively. Immigrants were least likely to be ecologically place dependent. This, in turn, affects the degree to which environmental change can affect the migration decision-making process. The next chapter looks at the ways in which ecological place attachment, ecological place dependence and mobility vary between locations and how this shapes the likelihood of migration under future environmental change.

6 The role of place in influencing the migration decision and ecological place utility

6.1 Introduction

Chapter Five investigated how people gained utility from place and the degree to which ecosystem services contributed to place utility. It found that instrumental bonds to ecosystem services such as farming as an income source are not a prerequisite for affective bonds to ecosystem services and the impacts of environmental change on place utility will extend far beyond those engaged in farming.

This chapter investigates the impact of location on the likelihood of migration as a response to environmental degradation. It examines the following hypotheses: that rural settlements are not uniform in the degree to which they gain satisfaction from ecosystem services; that different socio-ecological systems are associated with different migration systems; and that ecosystem services, by influencing the development of a settlement, influence its potential to create migration under environmental change.

This chapter disaggregates the population in four groups based on the four settlements sampled and findings are representative at a village level. Multi-dimensional measures of mobility, ecological place attachment and ecological place utility allow comparison of migration systems and level of dependence on ecosystem services within and between settlements. A quantitative model is assembled. It uses the results of the previous chapter on ecological place dependence and ecological place attachment in order to determine differences among the population in of place utility to changes in ecosystem services. It uses the findings of Chapter Four on satisfaction, mobility and mobility potential in order to determine who can act on a decrease in utility with migration. Results are disaggregated by settlement.

The chapter finds benefits gained from ecosystem services vary with settlement and can be explained by location-specific factors. Return migration was associated with higher dependence on farming and immigration with higher levels of off-farm employment. The framework, implemented as a quantitative model, predicts an increase in dissatisfaction for large proportions of the populations of the settlements under environmental change, but shows very little potential for out-migration.

This chapter has four sections, each analysing environment-migration interactions from a different perspective. The first section begins by describing qualitatively how the development of one of the settlements, San Mateo, has been influenced by the interaction of ecosystem services with socio-economic variables and how this in turn has led to the development of a particular

migration system dominated by immigration. The second section analyses differences between settlements with respect to mobility and place utility as defined in Chapters Four and Five. The third section uses a ternary diagram to look for relationships between migration systems and use of ecosystem services between and within settlements. The final section populates the model to provide a categorisation of five possible responses to environmental change, based on the characteristics of the sample population.

6.2 Prologue: The transition of San Mateo from an agricultural settlement to an urban commercial centre

Overall, Chapter Six focuses on the analysis of quantitative data to describe and explain differences between the settlements with respect to their ecosystem services and their migration systems. The sense that the suite of ecosystem services available to each settlement has been a driving force in its development emerges, however, from qualitative analysis of changes and developments that have taken place. This section provides a brief overview of how San Mateo transitioned from an agricultural village to a commercial centre as a result both of the increase in mining in the area and the unproductive nature of agriculture leading to the domination of immigrants in the population.[1]

The mining industry has been located in this area for at least a generation as demonstrated by those immigrants who moved to the area as children when their parents arrived for work in the mines. The existence of mining in the area explains the presence of immigrants from distant locations such as Huancavelica, a Department in the south of Peru, since when mines close in one area workers look for other mining centres. A proportion of local migration results from the continual opening, closing and reopening of local mines due to the fluctuating price of minerals. The introduction of the mining industry and the associated service industries brought about an increase in the population of San Mateo. San Mateo has been a mining town for at least two generations, but population appears to have burgeoned only in the most recent decades.

San Mateo is no longer an agricultural village for various reasons. Firstly, the presence of various mines and factories (e.g. mineral water bottling plant, lime production plant) and associated services industries mean there are other job opportunities for the younger generation. Secondly, the climate is not amenable to the production of cash crops and the thermal growing season is shorter than in the lower reaches of the valley, reducing the attractiveness of agriculture as an income source. Farming as a way of life is devalued; parents do not want their children to be farmers like them. One senior member of the community attributed the demise of agricultural

[1] Sources: explanations of why people had changed the crops they grew, explanations of why quality of life in the village was better or worse than how it had been previously, reasons for immigrating and explanations of how people arrived in the village, interview with mechanic on the *carretera central*, interview with president of the *comunidad campesina* for San Antonio.

production in the village to its own past successes. Families made rich through agriculture sent their children to Lima to be educated, but who then never returned to the village to continue farming.

The number of uninhabited houses in the historical centre of the village provides some evidence of this period of high emigration. Their owners live in Lima and return to their properties only for holidays. This, in turn, affects the immigrants to the area, who are forced to build their houses up the hillsides on the edge of the village. The number of households working in the informal sector is more than double that in other villages; evidence of its attraction as a commercial centre. Although only a small percentage of the population (around 12 per cent) works in the mining industry, the presence of mining and other extractive industries have led to the growth of service industries and an associated urban population.

As mentioned previously, the climate does not permit the cultivation of cash crops such as fruit. The market for crops which thrive in this climate, for example potatoes, no longer exists to the same extent as earlier in the 20th century, due to competition from other regions more suited to agriculture (valleys such as Huancayo and the irrigated coastal areas) and the popularity of carbohydrates such as rice and pasta. However, in the past San Mateo was predominantly agricultural, producing a large amount of potatoes to supply the population in Lima. A train previously transported produce to Lima but now mining companies control that route.

The few residents that do continue to farm are part of the older generation and lament the lack of sense of community that used to be associated with everyone going to the fields together and the celebrations around harvest time. An example of the scale of agriculture in the region was that many of the older immigrants had arrived in the village as teenagers looking for temporary work harvesting alfalfa. More recently, young people arrive to find work in the restaurants that service the long distance coaches that pass through the village on the way to Huancayo and cities in the jungle. Immigrants face institutional problems if they attempt to take part in agricultural activities, in that *comunidad campesina,* the organisation that controls rights to the land, tends to be conservative and is reluctant to provide access to land that is already in short supply to newcomers to the village.

San Mateo, although one of the furthest from Lima, is the settlement most materially well-off of those surveyed. The informal sector and salaried labour dominate and the off-farm labour market is diverse. The majority of households rely entirely on off-farm income. Education is an important driver of dissatisfaction and may explain the fact that levels of return migration are low, since once educated there are few opportunities for income in the village.

This section has demonstrated that the influence of ecosystem services on migration begins long before environmental degradation affects an individual's place utility. The ecosystem services available in location have an important influence on the development of the settlement, the dependence of its population on ecosystem services and the kind of migration system that takes shape. This in turn affects the potential for migration due to environmental change. The following section analyses relationships between ecosystem services and mobility profiles at the settlement level and in the present, before continuing to examine how these relationships may lead to different migration outcomes under environmental change.

6.3 Differences between settlements with respect to mobility and ecosystem services

This section analyses the differences between towns with respect to their ecological place attachment, the migration history of their inhabitants (the type of migration system that exists) and the use of ecosystem services for income. The population of each village values ecosystem services to different degrees. It also values different kinds of ecosystem services within those categories, in relation to the kind of services available and other non-ecosystem benefits that attract them to that location.

There are no significant differences between the populations of the settlements with respect to levels of satisfaction. Although differences are not statistically different, Chocna, the village that is most remote and most dependent on agriculture has a higher satisfied portion of the population. In Chocna 62 per cent of the population is satisfied compared to 44 per cent, 46 per cent and 45 per cent in Caruya, San Mateo and Surco respectively. However, contributors to place utility, and especially ecological place attachment, did vary significantly between the villages. San Mateo, due to its larger sample size drives the mean categories described in Section 5.4.

The contribution of environment and climate factors was significantly different between Caruya, San Mateo and Surco at the 90 per cent confidence interval. The population of Caruya mentions ecosystem services the most (94% of the population), which is more than Surco where 64 per cent mentioned climate and environment factors. In San Mateo 51 per cent of the population mentioned climate and environment aspects of their location. Climate and environment factors were the most frequently mentioned contributor to place attachment in all settlements.

The results show that the populations of the villages value environmental and climate aspects to different degrees. The settlements also value different kinds of ecosystem service to varying extents as shown in Figure 6.1.

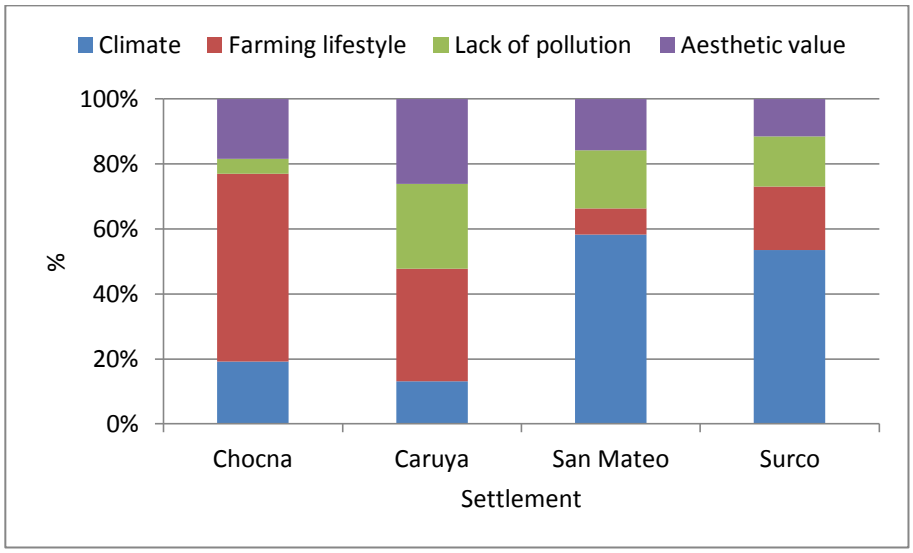

Figure 6.1: Types of ecosystem services mentioned by the population of each town. Appreciation of the climate increases as the climate becomes warmer. The differences between the rural annexes, Surco and San Mateo were significant with respect to valuing the farming lifestyle.

Climate was mentioned most frequently by residents of Surco (47%), followed by the inhabitants of San Mateo (37%), then by Chocna and Caruya (20 and 19% respectively). It is interesting to note that the percentage of the population that mentions climate as a positive aspect of their settlement, increases as the climate becomes more mild The difference between Surco and the two rural annexes is significant at the 90 per cent confidence interval. With respect to the farming way of life, there were significant differences between San Mateo (5%), Surco (17%) and Chocna and Caruya (60 and 50% respectively). The number of people mentioning lack of pollution and the aesthetics of the zone did not vary significantly between the different settlements, although the population of Caruya was more likely to have mentioned these two characteristics.

Figure 6.2 shows the differences between settlements with respect to the mixture of non-migrants, return migrants, imkmigrants and return immigrants. San Mateo and Surco have statistically significant different levels of immigrants in their populations. There are no other statistically significant differences between the settlements. This may relate to the small sample size of Chocna and Caruya, since one would expect a significant difference due to the very differing proportion of immigrants between San Mateo and Chocna.

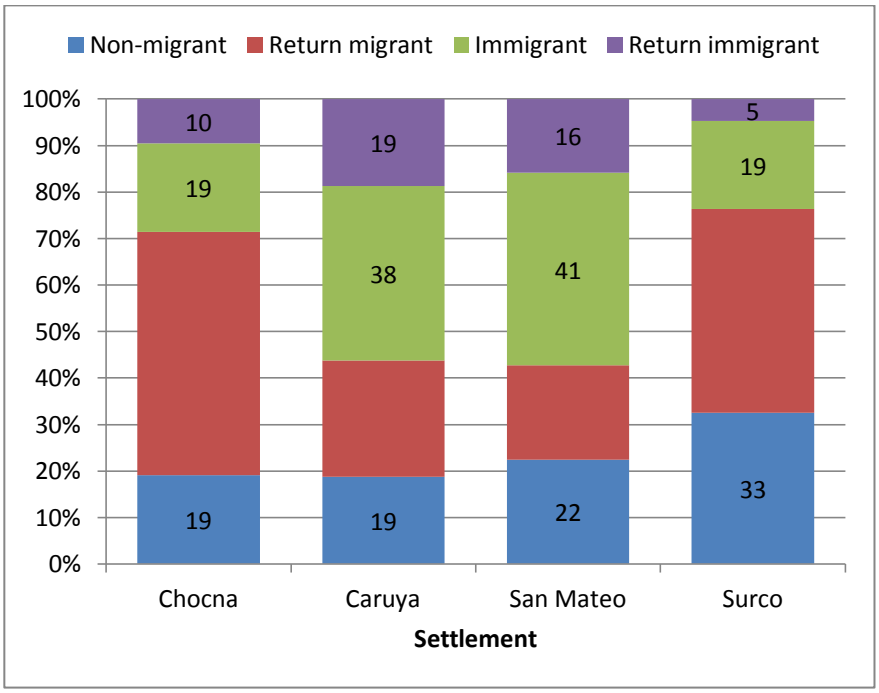

Figure 6.2: Migration system of each settlement. Immigration dominates in San Mateo, and is significantly different from Surco in this respect. Both Caruya and San Mateo have large proportions of immigrants, while Chocna and Surco have large proportions of return migrants. Surco has roughly 50% more non-movers than the other settlements.

The brief analysis in this section has demonstrated that different settlements within a short distance of each other have different mobility profiles and different use of, and attitudes towards, ecosystem services. It argues that differences in the available ecosystem services at each of these locations, driven by changes in altitude, accounts for a proportion of this variation.

Although the fact that all settlements are different is not a result in itself, it is part of the story when trying to understand how migration under environmental change may occur. Also, it is a fact that is often overlooked when scholars discuss environmental migration and a potential increase in rural to urban migration because of environmental degradation. There is a tendency to assume that rural populations will be the most affected by environmental change due to a greater reliance on natural resources for income, but some rural locations are barely dependent on provision ecosystem services for income at all. This highlights the importance of looking at utility gained from non-provisioning ecosystem services.

These differences, based on the model put forward in Chapter Two, which forms the structure of this analysis, mean that these rural locations will show very different responses to environmental change. The following section compares differences across villages using a ternary diagram to provide a multi-dimensional space that allows simultaneous comparisons of differences within and between settlements. The analysis includes mobility characteristics of the settlement, level of

dependence on farming (instrumental attachment to ecosystem services) and a measure of place attachment (ecological, social/emotional or amenities and services related to place).

6.4 Comparing settlements on ecological place utility and mobility

This section investigates the interactions in place between place attachment, dependence on ecosystem services and migration system. Figure 6.1 is a ternary diagram that plots three dimensions of each of these characteristics on one space for each of the four settlements. The analysis uses one tri-variate measure to act as a proxy for each characteristic. In this way, the characteristics can be plotted on a ternary diagram that allows visualization of associations between, within and across settlements.

The diagram plots three characteristics for each of the four settlements: place attachment, reliance on farming for income and the migrant mix of the population. Each of these characteristics has three dimensions. The location of a point at an apex would mean that 100 per cent of the population exhibits the characteristic labelled at the apex (e.g. a settlement's population would be composed of 100% migrants or 100% of the population would have exhibited attachment to ecosystem services and nothing else). A location on the side of the triangle would mean that zero per cent of the population exhibits this dimension of a particular characteristic. In reality, each village shows a combination of all three dimensions. The different locations of the points demonstrate how settlements differ with respect to the composition of their place attachment, migrants or dependence on farming. See Appendix 5 for calculations and supporting data for the ternary diagram.

In order to make each characteristic tri-dimensional, aspects of place attachment were re-coded into three groups, normalised to 100 per cent and the immigrant categories (immigrant and immigrant that had left and returned) were combined into one category. Farming mix in the household was already a tri-dimensional characteristic.

Purple squares represent the characteristic of place attachment recoded into three dimensions: place preferences, ecosystem services and social/emotional. The social/emotional category includes the 'Friends, family and social events' and 'Emotional attachment' categories from Chapter 5. The place preference category groups the 'Safe/uneventful', 'Work related', 'Services and amenities of the town' and 'Peace and tranquillity' categories from Chapter 5. The ecosystem services group remains the same.

Blue squares plot the village on the diagram with respect to the reliance of its population on farming for income, represented by the proportion of the households that were either fully farming, fully off-farm or mixed with respect to their income source. Red data points represent the mobility profile of the population and the proportion of the population that is a non-mover,

return migrant or an immigrant. Appendix Six contains calculations for the ternary plot, created using a Excel spreadsheet containing formula to convert data to points on the ternary plot.

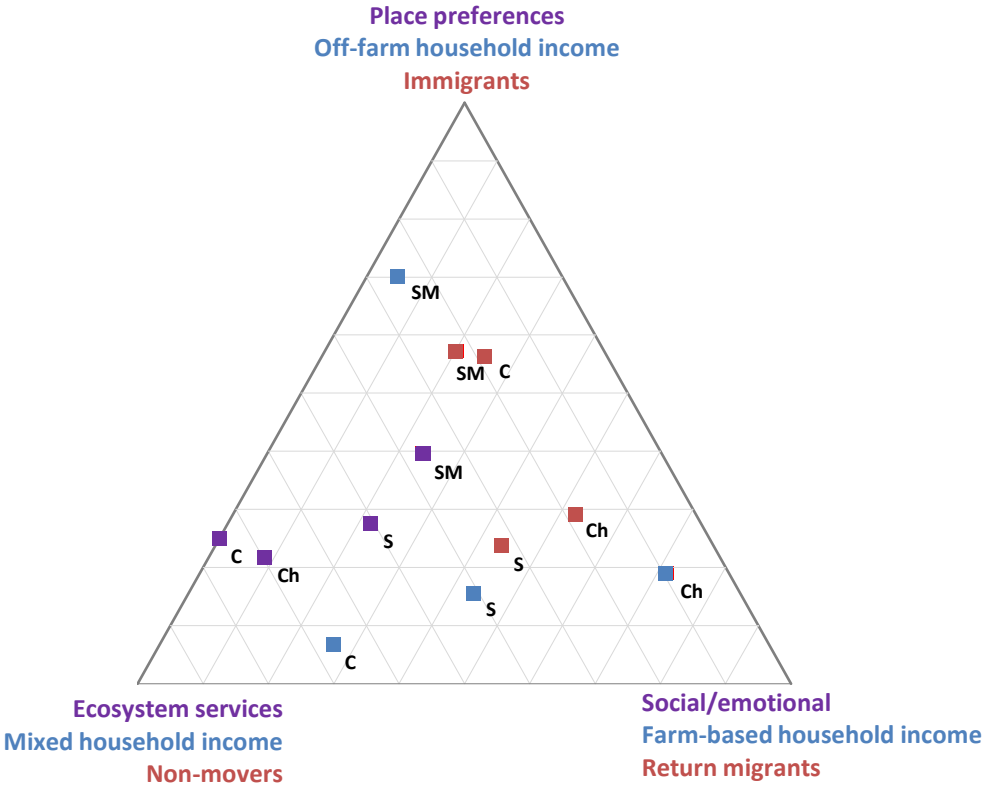

Figure 6.3: Ternary diagram allowing comparison of three dimensions of three characteristics for the four settlements sampled. The diagram shows that reliance on farming may or may not be associated with attachment to ecosystem services. However, higher levels of farming appear to be associated with more return migration and off-farm incomes with more immigration. Ch = Chocna; C = Caruya; SM = San Mateo; S = Surco. Dimensions of place attachment are shown in purple, dimensions of farming income shown in blue and dimensions of migration characteristics shown in red.

With respect to place attachment, in all settlements the survey population mentioned social/emotional aspects very little. San Mateo and Surco mentioned ecosystem services and place preference aspects fairly equally and Chocna and Caruya showed a preference to ecosystem services over place preferences.

The settlements show distinct patterns with respect to the degree of dependence on farming in households. In San Mateo, the majority of households are off-farming, with 25 per cent mixed income and only 5 per cent fully reliant on farming for their income. This situation is reversed in Chocna where 70 per cent of households are fully dependent on farming for income. In Caruya nearly 70 per cent of households depended on both farming and off-farm income sources, diversifying their household income source. Surco was situated between Chocna and Caruya with the majority of households having either a farming or mixed income source, but very few relying only on off-farm incomes.

In Chocna, twenty per cent of the population has never lived outside the village, 50 per cent of the population has lived outside the village and returned and 29 per cent of the population are immigrants. Nineteen percent of the population has never left Caruya, 25 per cent has left and come back, 56 per cent of the population are immigrants. Twenty-three percent of the population of San Mateo has never lived in another location, 20 per cent has lived elsewhere and come back, 57 per cent are immigrants. In Surco, a third of the population has never lived anywhere else, 44 per cent of the population has left and come back and immigrants make up 24 per cent of the population.

The clustering of the points on the ternary diagram shows that certain villages are very similar with respect to some characteristics but very different with respect to others. San Mateo and Caruya have very similar migration profiles with a high level of immigrants and similar levels of non-movers and return migrants. However, the percentage of households relying on off-farm income source is at almost opposite ends of the scales. Similarly, despite very different migration and farming profiles, Chocna and Caruya have very similar place attachment profiles, favouring ecosystem services. Looking at clusters of data points, migration and dependence on farming for income are similar for Chocna and Caruya suggesting that high dependence on farming for income source is associated with higher levels of return migration. The migration and rurality points for San Mateo are grouped at the other end of this scale suggesting that high levels of households with off-farm incomes are associated with high levels of immigration.

This analysis shows that in the surveyed settlements, dependence on agriculture for income is not necessarily a predictor of attachment to ecosystem services, that agricultural incomes may be more associated with return migration rather than immigration and that immigration is associated with the level of off-farm income sources. It warns against using measures such as distance from the capital city or size of settlement as proxies for dependence on farming or type of migration system that dominates, since farming and type of migration varied independently of size and access to Lima.

6.5 A decision model for understanding impact of degradation of ecosystem services on migration decision-making

This section presents a decision model that acts as a heuristic tool to understand the likelihood of migration under environmental change. The decision tree functions by working through all possible combinations of characteristics identified in the preceding analysis as important in determining migration as a result of environmental change: dependence on ecosystem services, attachment to ecosystem systems, place utility, mobility and mobility potential. The proportion of the population associated with each branch of the model can be quantified since data were collected on each of these characteristics for each member of the sample. Disaggregating the

analysis by settlement reveals how place, by influencing these characteristics, mediates the impact of environmental change on its population.

6.5.1 The decision model

The decision model does not represent the decision-making process undergone by an individual. It exists at the meta level and classifies individuals based on the characteristics of their place utility, mobility potential and barriers to migration. Each group experiences the change in ecosystem services differently and will have different capacities to respond to changes in their place utility.

Based on the framework presented in Chapter Two, there are five components important in determining the outcome of environmental change on the migration decision-making of the individual: ecological place dependence (farming as an income source); ecological place attachment (ecosystems as a contributor to sense of place), place utility (positive or negative), mobility (based on age and education) and mobility potential (social and psychological barriers to migration). A dichotomous variable represents each of these in the decision model.

The degree to which the environment affects the migration decision-making process depends on the ecological place utility of the individual. Ecological place utility is a function of dependence on ecosystem services for income through farming and the contribution of ecosystem services to place attachment. The first step in the decision model categorises individuals by whether they rely on farming as an income source. The second layer categorises individuals by whether ecological characteristics contribute to their sense of place.

A change in utility gained from ecosystem services will have a outcome depending on the initial utility of the individual. A person with positive place utility will move to negative place utility and consider migrating. A person already in a state of dissatisfaction will reassess the costs and benefits of migration over remaining in location. Therefore, the next branch of the decision tree categorises individuals by whether they are currently satisfied or dissatisfied, identified using methods defined in Chapter Four. A new variable on satisfaction was made reversing the values of the considered_migration variable. If a person had considered migration (1 in the considered_migration variable) they were now coded as 0 to represent a negative place utility. If a person had not considered migration they were coded as 1, to represent a positive place utility.

Whether or not people can act on negative place utility is a function of their physical mobility and their mobility potential. Both are included as steps in the decision model. The model considers an individual mobile if they are under thirty and have secondary education. Thirty was the age at which the majority of people stopped migrating in the survey population. Education is a common predictor of migration (White and Lindstrom 2005) and a completed primary school education

was chosen as the level necessary to be mobile. This level of education was chosen based on anecdotal evidence from the field site. A dichotomous variable splits the population by those under 30 with secondary education and over thirty with primary education.

The final level of the decision tree divides the population by their mobility potential. If a person would leave if they had the money to do so, the model considers their barriers financial and they are assumed to have a high mobility potential. If an individual has answered negatively to the same question, this indicates a social or emotional reason for the person staying in location despite dissatisfaction. In this case, the model classifies this person as having low mobility potential.

Various assumptions drive the outcomes of the decision tree. Firstly, that low physical mobility is a stronger force than high mobility potential, meaning any person who is over thirty with no secondary education does not act upon their dissatisfaction with migration. Secondly, the decision model assumes that a satisfied person will chose temporary migration in response to a fall in income, rather than permanent emigration from the settlement. The third assumption is that a person who is dissatisfied will chose permanent migration over temporary migration. A final assumption is that migration cannot counteract a decrease in ecological place attachment but that it can counteract a decrease in ecological place utility. Figure 6.4 depicts the decision tree graphically and shows the different groups of outcomes. The following discussion describes the different outcomes of the decision.

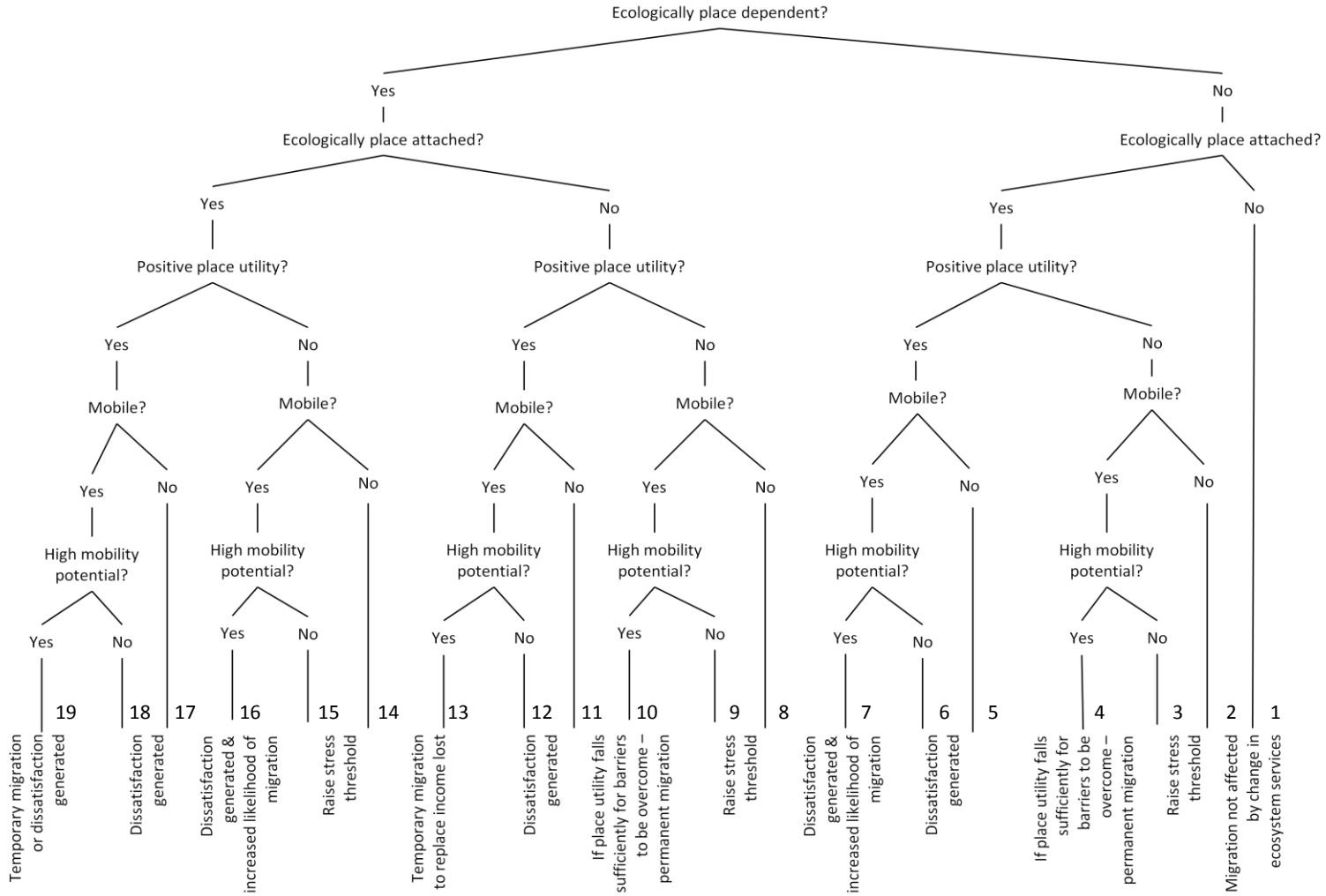

Figure 6.4: Decision tree for determining the potential outcome of a fall in ecosystem services on an individual based on the utility and mobility characteristics of the individual. The decision tree produces nineteen decision group outcomes showing seven different responses to environmental change.

6.5.2 The impact environmental change on the migration decision

The decision tree model, based in behavioural migration theory, proposes six potential impacts of environmental change on the migration decision-making process. An individual may:

- Be forced to raise their stress threshold;
- Begin to experience dissatisfaction when place utility was previously positive;
- Be unaffected by changes in the environment;
- Migrate permanently if place utility falls sufficiently to overcome financial barriers;
- Show an increased likelihood of migration, if dissatisfaction is generated in an individual with characteristics of high mobility; or
- Use temporary migration to meet a fall income that may also be accompanied by a newly dissatisfied state.

Some groups reflect a step forward in the migration decision-making process – people who are currently not dissatisfied but begin to feel dissatisfaction. If high mobility and mobility potential accompany this dissatisfaction, these individuals are more likely to undertake migration in the future. Individuals who are dissatisfied and currently kept in location by financial barriers, may reassess those barriers in light of an increase in dissatisfaction in location. However, other individuals have nowhere to progress along the migration decision-making process – an individual who is already dissatisfied and trapped by demographic immobility or low mobility potential can only absorb more dissatisfaction.

The following section discusses each of these potential outcomes in more detail. Table 6.2 and Figure 6.4 show the proportions of the population which are categorised into each of these response groups. Appendix Seven contains the cross tabulations from SPSS quantify the decision model. It provides output by each of the nineteen branches of the decision tree, whereas Table 6.2 groups the output by type of response.

According to the decision model, in 31 per cent of individuals, changes in ecosystem services will not directly affect the migration decision-making process. These individuals are those that do not work in farming or have an ecological component to their place attachment. While variations in place utility, mobility and barriers will continue to create differences in migration outcomes, this process will be unaffected by environmental change.

Response to a degradation of ecosystem services	Whole population (%)	Chocna (%)	Caruya (%)	San Mateo (%)	Surco (%)
Raise stress threshold	32	30	50	26	39
Dissatisfaction generated	32	60	31	25	37
Migration not affected by changes in ecosystem services	31	5	6	44	17
Permanent migration if place utility falls sufficiently to overcome barriers	3	0	0	4	4
Dissatisfaction generated and increased likelihood of migration	2	5	13	0	2
Temporary migration or dissatisfaction generated	0	0	0	0	0

Table 6.1: Percentage of population in each migration decision response group, for the population as a whole and by settlement.

However, this group is not immune to progressive degradation in ecosystem services. Many people in this group work in service industries and would eventually be forced to leave if the population was not sufficient to support their business or if population levels fell sufficiently for key services such as schools to close down (e.g. Arenstam Gibbens and Nicholls 2006). In addition, a decrease in water supply has the potential to affect people working in extractive industries since these processes are dependent on large quantities of water and activities may become more seasonal.

At the opposite end of the scale are individuals that have the mobility to migrate permanently if dissatisfaction increases sufficiently to overcome financial barriers. Three percent of the sample has the potential to relocate, and relocate permanently away from the location, if the decrease in utility is sufficient to encourage them to overcome existing financial barriers to migration. This group is likely to move permanently because they are already dissatisfied with location for other reasons and they have both high mobility and high mobility potential. Whether they migrate is highly dependent on whether a change in the benefit gained from ecosystem services reduces their utility sufficiently for them to reconsider the barriers that currently keep them in place.

The model did not predict the use of temporary migration for anyone in the surveyed population. This group would be composed of farmers, with a current positive place utility and no social barriers to migration. This group is likely to use temporary migration rather than permanent migration because they are currently satisfied with place and so will use migration as a means to

stay in place. Migration is an effective response to environmental change because these farmers have no attachment to the non-provisioning ecosystem services, and this group would have the mobility to react in this way. If the farmer were also emotionally attached to ecosystem services, the fall in income would also be accompanied by a fall in utility and a potential loss of commitment to the location.

In general, however, the potential for migration to be a successful adaptation is limited. Satisfied farmers, who could use temporary, cyclical migration to replace income lost from a degradation of ecosystem services, are one of the most immobile groups. Migration is a successful adaptation to environmental degradation if the sole reason for inhabiting the village is work and work in a similar field exists elsewhere. An example of this is that some male respondents have come to the village to work in the mines and are use to transferring between mines.

Prior to temporary labour migration a potentially mobile, satisfied farmer has other options, such as farm work for other more entitled, more adapted, or less impacted farmers or casual labour in off-farm activities in the village. If there is a large off-farm labour market, or the person has a high place attachment to other aspects of the village (i.e. social or security aspects), they are unlikely to leave. This will depend on the nature of the individual and their intrinsic mobility potential. Groups 9,8, 11 and 12 which represent farmers, both satisfied and dissatisfied with low demographic or intrinsic mobility potential, who are not ecologically place attached, are classified in the model as having to raise their stress thresholds. However, if there are alternative farming or off-farm income sources available to them, it may be that they can address the fall in satisfaction by finding alternative sources of income in their settlement.

Thirty four per cent of the population begin to experience dissatisfaction when their place utility was previously positive. However, only two percent of the population has the mobility characteristics that would enable them to act on that dissatisfaction through migration; in the large majority of the population that begins to experience dissatisfaction, there will be no external change.

In a similar vein, environmental change will negatively affect 32 per cent of the population that is already dissatisfied with location and unable to act upon the dissatisfaction with migration. This group is composed of individuals have low mobility potential and/or low demographic mobility characteristics and are currently dissatisfied. The size of the increase in dissatisfaction depends on the capacity of the individual to adapt in situ. Although finding alternative sources of income addresses dissatisfaction related to a loss of income, an individual has limited potential to adapt to dissatisfaction driven by loss of cultural and provisioning ecosystem services.

Figure 6.5 shows how proportions of the population in each outcome group vary between settlements. San Mateo has highest proportion of people unaffected by environmental change because of the low levels of access to land. Those who have their place utility are people who ecological place attached. Chocna has a high proportion of the population that moves from positive to negative because it currently has an above average level of satisfaction and a large ecologically place dependent population. Caruya has the largest proportion of the population forced to raise their stress threshold – meaning this settlement has a high proportion of dissatisfied people that are either dependent on or attached to ecosystem services. Surco's distribution is the most evenly spread, representing perhaps the mix of farm and off-farm incomes that there are in Surco. It also shows that the dissatisfied and satisfied are spread across the different income types. The model predicts migration in only a small percentage in all settlements.

The decision model highlights the weakness in migration as an adaptation to climate change. Migration cannot replace utility lost from ecosystem services to which people have formed an emotional attachment. Although, people may leave because they feel less attached to their location because something to which they were attached has been degraded; migration does not allow them to regain that utility. In this situation migration may well occur as a result of environmental change, but it is not an adaptation to environmental change. Furthermore, a large proportion of the population demonstrates low mobility characteristics and migration is not a possibility for them. In this case, migration could mean an improvement in wellbeing, or at least the chance of improving wellbeing. These individuals have lost attachment to place because the location fails to meet their aspirations and needs.

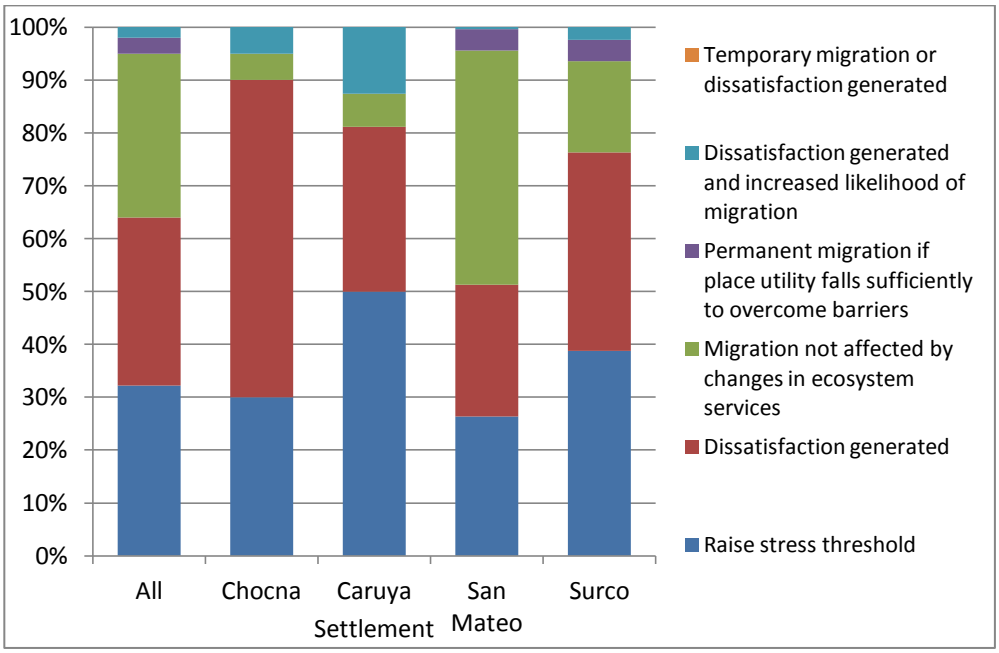

Figure 6.5: Proportion of population in each migration decision response group by settlement. The most conspicuous result is that none of the settlements have a large proportion of the population that would experience a decrease in place utility because of environmental change and be able to respond to that decrease through migration.

6.6 Discussion

The analysis in this section addresses three hypotheses on the impact of place specific factors on the decision to migrate. The first hypothesis relates to differentiation between settlements with respect to the ecosystem services from which their populations gain benefit. The settlements differ with respect to the proportion of the population that is ecological place attached (affective attachment to ecosystem services). The level of ecological place attachment varied with the proportion of the population that relied completely on farming for income.

The type of ecosystem service to which the population formed attachment also varied between settlements, showing much stronger relationships than when disaggregated by income or migrant groups. The differences in the ecosystem services to which people form attachment reflect the different endowment of ecosystem services at each of these locations. The proportion of the population that mentions the climate as a positive aspect of life in the village increased as the climate becomes more amenable to agriculture and more desirable for humans. Attachment to the rural way of life is associated with a mixture of increase in dependence on agriculture and accessibility.

The second hypothesis is that different socio-ecological systems can be associated with different migration systems. The validity of this statement depends on the socio-ecological indicators that are considered in the analysis. The research found the rural settlements to be unpredictable with respect to various indicators of rurality, two settlements could be very similar on one variable but at opposite ends of the scale for another variable. For example, as found in the analyses in

previous chapters by income groups, dependence on agriculture in the settlement did not necessarily mean that the population was attached to that lifestyle. Access to land could be associated with very high levels of farming only households or high levels of mixed income households.

High levels of immigration were associated with more off-farm households; high levels of return migration were associated with high levels of return migration. However, it is not as simple as saying that immigration is a function of low access to land since high immigration can be associated with both extremely high and extremely low access to land in a settlement. Therefore, a key result of this part of the analysis is to demonstrate caution in generalising about socio-ecological systems in rural locations, even in settlements very close to each other. Endowments of ecosystem services vary over short distance. This means that socio-ecological systems can vary over short distances, and lead to the development of very diverse migration systems.

Although all these villages are rural, each location meets the needs of its population in different ways and to the same extent, since place utility remains constant across the villages. The differential development of the settlements may mean a different level of resilience to externally imposed change. The more agrarian communities are hardened to change because they have survived multiple socio-economic upheavals including agrarian reform, political violence and the implementation of neo-liberal economic policies. The boomtowns which are thriving as a result of mining industry have yet to survive such tests on their longevity.

The final hypothesis on place is that ecosystem services, by influencing the development of a settlement, influence its potential to create migration under environmental change. The model was implemented quantitatively in order to assess the impact of place on the potential of each settlement to produce migration as result of environmental change. The results both support and refute the hypothesis. In terms of changes in the levels of dissatisfaction of the population, the model predicts different changes in each settlement depending on the proportion of the population that gains utility from ecosystem services and initial level of satisfaction. However, there is no difference between villages in the potential for environmental change to induce migration; the ability to counter decreased satisfaction with migration is consistently low.

6.7 Conclusion

This chapter has explored some of the diversity in rural settlements and the ways in which ecosystem services drive that diversity. It warns against making generalisations and the careless use of proxies to represent rural characteristics.

The framework presented in Chapter Two was operationalised using survey data and findings from the preceding two chapters. In the model, migration under environmental change becomes a function of ecological place dependence, ecological place attachment, starting place utility, mobility and mobility potential. The model predicts five possible outcomes with respect to the migration decision-making process: use of temporary migration; a shift in place utility from positive to negative, raised stress thresholds, overcome barriers to migration, or no impact on migration decision-making process. The model did not predict temporary migration for any member of the survey population and permanent out-migration was only a possibility in eight per cent of the population.

The model provides an assessment of the likelihood of different groups of individuals migrating under environmental change based on their mobility potential and place utility characteristics. The model could be tested through longitudinal studies, monitoring which individuals leave a site under environmental degradation. Alternatively, the mobility patterns of households in 'good' years, and years where water resources were in short supply could be compared. In the 'bad' years, the mobility decisions of households in each category could be analysed as they were taking place.

The next chapter provides a brief overview of the results of the empirical chapters before summarising the overarching results of the thesis. It then discusses the contribution of these findings to relevant theory and concludes the thesis with some closing remarks on the approach taken in this research.

7 Discussion/Conclusion

7.1 Introduction

The theoretical framework proposed in Chapter Two and implemented in this empirical study unites the concepts of ecosystem services and migration decision-making, taking into account the importance of location in both these processes. The previous three chapters have described the results of applying the theoretical framework to a rural-urban migrant sending area in the highlands of Peru.

Chapter Four focused on the behavioural aspects of the framework and investigated the interaction between mobility potential and place utility. Behavioural migration theory gave rise to three hypotheses: that the population contains both satisfied and dissatisfied members and dissatisfaction is represented by initiating the migration decision-making process; that high mobility potential and low utility members will not be present in the population, but if present will be subject to resource barriers to migration; and that high place utility is a function, in part of the population, of low mobility potential.

Chapter Five investigated the contribution of ecosystem services to place utility, disaggregated the benefit gained from ecosystem services, investigated and assessed the relative roles of instrumental versus affective bonds to ecosystem services in creating utility. It also addressed three hypotheses based on the concepts of ecosystem services, namely: rural populations gain a large proportion of their utility from ecosystem services, utility gained from ecosystem services varies among the population and that the kind of utility gained from ecosystem services varies between sub-groups of the population.

Chapter Six disaggregated the analysis by location. Three hypotheses drove the analysis: that rural settlements are not uniform in the degree to which they gain satisfaction from ecosystem services, that different socio-ecological systems are associated with different migration systems and that ecosystem services, by influencing the development of a settlement, influence its potential to create migration under environmental change.

This final chapter begins by summarising the results of the empirical application of the framework. The chapter continues by providing a summary of the key findings of the thesis. The implications of the findings for Peru are briefly discussed before discussing the contribution of the research to wider theory. The chapter and thesis conclude with some general reflections on the wider implications of the research.

7.2 Summary of results

The empirical chapters were structured around the framework presented in Chapter Two and shown in Figure 7.1 below. Chapter Four investigated the interaction between mobility potential and place utility. Chapter Five investigated the contribution of ecosystem services to place utility and Chapter Six disaggregated the analysis by location. Chapter Six also united the different components of the model and sorted the population based on the ecological place utility, place utility and mobility characteristics of the individual. This section briefly reviews the key results of the empirical chapters.

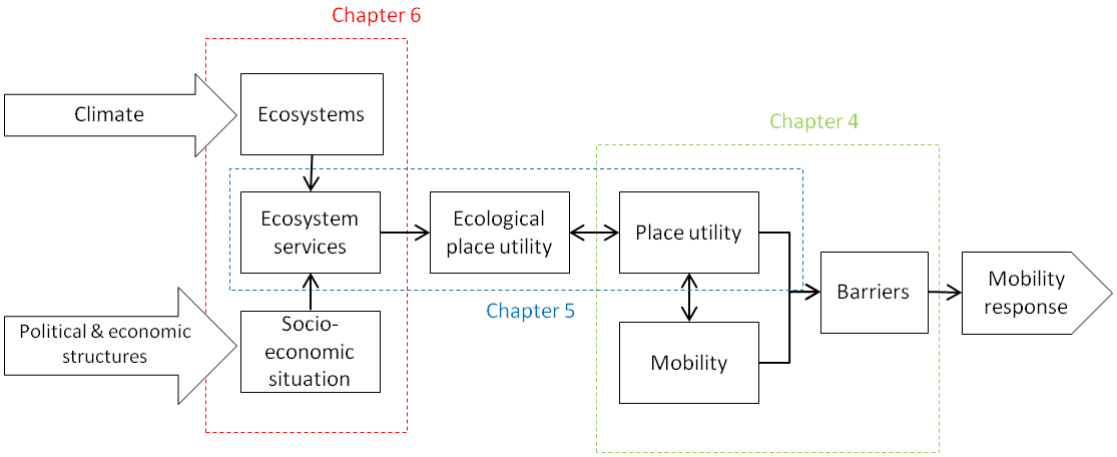

Figure 7.1: Analytical framework for predicting migration due to environmental change, using ecosystem services as the key analytical link.

Chapter Four finds that initiating the migration decision-making process reflects dissatisfaction with location, consistent with Speare (1974). The population is divided almost evenly between positive and negative place utility, and consistently across migrant groups, employment types and settlement. Coding and clustering of drivers of dissatisfaction gives rise to groups consistent with anticipated self-perceived drivers of migration: work, a lack of educational opportunities and possibilities, life-cycle stages and seeking change and adventure. Work reasons related to both an absolute shortage of work and a desire to improve income. Financial concerns only represented a quarter of the barriers to migration showing that the majority of the individuals with negative place utility and high mobility have found a way to overcome financial barriers.

High mobility potential and negative place utility individuals are found in the population, however it is social barriers to migration, not financial barriers to migration that keep these individuals in location. High place utility was not associated with low mobility potential, and in fact, evidence pointed to the contrary. Farmers, a group more likely to exhibit low mobility potential were also a group more likely to be dissatisfied with location. Put another way, stronger sense of place does not accompany a reluctance to leave. Nor does a lack of capacity to migrate drive low mobility

potential: indicators of mobility potential and mobility do not correlate with each other. This reflects the strength of social barriers to migration.

Chapter Five finds that the benefit gained from ecosystem services is not limited to provisioning services used by farmers and others directly dependent on natural resources for income. Benefits gained from location reflect the 'urbanophobic' (Félonneau 2004) nature of individuals that prefer the services and lifestyle that rural locations offer over those of an urban location. Ecosystem services feature strongly in the survey responses but work, services and amenities featured infrequently. Social factors are mentioned infrequently, reflecting low social capital because of the mobility profile of the settlements. These locations are marginal with respect to work and the support of the state. Respondents value safety and tranquillity of village life, reflecting the small size of the settlement in rural locations and often mentioned it in comparison with Lima.

Differences were observed in between certain groups with respect to utility gained from ecosystem services. The sub-group of the population that mentioned ecosystem services most frequently was farmers while business owners mentioned ecosystem services least. However, there were no other significant differences between income groups. Similarly, past migration behaviour of the individual has little effect on the ways in which people gain utility from their location, nor does it have an effect on the non-provisioning ecosystem services that people value, despite immigrants being less likely to have access to land. Patterns with respect to utility gained from different ecosystem services are less clear, the only significant relationship was that farmers were more likely to value the farming lifestyle.

Chapter Six finds that the type of ecosystem service to which the population forms attachment varies between settlements, showing much stronger relationships than when disaggregated by income or migrant groups. The differences in the ecosystem services to which people form attachment reflect the different endowment of ecosystem services at each of these locations.

Whether different socio-ecological systems can be associated with particular migration systems depends on the socio-ecological indicators used. The rural settlements are unpredictable with respect to various indicators of rurality, two settlements could be very similar on one variable but highly divergent on another. The results suggest caution when generalising about socio-ecological systems in rural locations, even in settlements very close to each other. Endowments of ecosystem services vary over short distance, this influences the development of different socio-ecological systems and the emergence of diverse migration systems.

The differences between settlements lead the populations having different exposure to environmental change with respect to their place utility and a different capacity to respond to a change in utility with migration. The settlements are likely to exhibit differences with respect to

changes in satisfaction because of environmental change. However, as a result of different combinations of ecological place dependence, ecological place attachment, starting place utility, mobility and mobility potential very few of the individuals in the settlements are likely to migrate as a result of environmental change.

7.3 Interpretation of results

This section highlights the three main findings of the research. Firstly, it explains why migration is sometimes the adaptation of choice and sometimes the adaptation of last resort. Secondly, it predicts an increase in dissatisfaction over an increase in migration due to loss of ecosystem services. Thirdly, it argues for a much-extended view of the beneficiaries of ecosystem services.

The concepts of place utility and mobility potential are able to explain why migration is sometimes the adaptation of choice and sometimes the adaptation of last resort – the question posed by McLeman and Smit (2006). The research has found that satisfied members of the population chose to trade-off other aspects of their wellbeing, such as higher income levels, in order to remain in location. The research has also identified dissatisfied members of the population unable to alter their level of dissatisfaction by migration due to financial or social barriers. These groups are more likely to use migration as an adaptation of last resort while people with high mobility will use mobility to address dissatisfaction over adaptation in situ.

This explanation has implications for the effectiveness of migration as an adaptation to climate change. The recent Foresight report on Migration and Global Environmental Change (2011) encourages governmental support for mobility and migration as an effective adaptation to environmental change. This research provides evidence that in sending areas, mobility and migration are an effective adaptation for that part of the population that have already experienced dissatisfaction. However, there are limitations to migration as an adaptation.

Firstly, as the results of Chapter Four demonstrate, the largest set of barriers to migration is that which relates to social factors. Even people with high mobility measured by demographic factors, such as age and level of education, are prevented from moving by their own low mobility potential and a psychological reluctance to leave. If the goal of the intervention is to increase the use of migration to help people escape the negative impacts of environmental change, policy interventions or the injection of cash are unlikely to make a difference to these kind of barriers, and to people who are trapped in location by their own reluctance to engage with the outside world or social obligations.

As Chapter Five illustrates, places where people live offer utility in a multitude of ways. In this study, few of these sources of utility relate to an income. Therefore, another weakness of migration as an adaptation to environmental change is that it ignores emotional attachment to

place. Moving to a less difficult environment, particularly if being forced through resettlement, may lead to a person being financially more stable but emotionally and socially much worse off (McMichael, Barnett et al. 2012). For those who are satisfied with location, migration can never be the optimal solution. Even though migration may replace incomes lost as a result of, for example, farming, migration is unable to replace those aspects of the natural (and man-made) environment to which the population had formed attachment and that are specific to place (Mortreux and Barnett 2009).

In general, the individuals studied in this research do not have high mobility. The most likely response to a fall in ecosystem services is not migration, but an increase in the proportion of the population that is dissatisfied or higher stress thresholds in those already dissatisfied. This in itself is not a novel finding; this population persists in marginal economic conditions despite its geographic proximity to Lima and the presence of highly developed migration systems and hence the low levels of mobility would be expected. However, the novelty lies in the two distinct reasons for people staying, each which requires a different policy response with respect to a fall in place utility.

Half of the population have a positive place utility and do not leave because the satisfaction they gain in that location is higher than they would expect to gain in the city. Policy interventions would help these people stay in location. The other half of the population is in location only because of barriers that prevent them from acting on their dissatisfaction through migration. Policy interventions targeted at this group would facilitate migration. Furthermore, the low mobility of these populations does not describe their inability to access alternative labour markets, their advanced age or low levels of education; it describes their intrinsic reluctance to migrate.

As highlighted in Chapter Two, some studies find rates of migration to increase with environmental degradation while others find migration decreasing. Sometimes the direction of change in rates of migration depends on the sub-group of the population under investigation. The conceptual framework predicts an increase in migration with degradation of ecosystem services because a loss of ecosystem services leads to a decrease in place utility. Chapter Six applied the framework using data from the survey population and predicted an increase in migration in only a small percentage of the population. The dominant impact of a degradation of ecosystem services will be an increase in dissatisfaction of the population with no externally visible changes in the composition of the population. Therefore, rural populations are likely to maintain themselves even in the face of climate change, but, as noted elsewhere, a proportion of that population will not remain in location out of choice (Suhrke 1994; Foresight 2011; Kartiki 2011).

Practitioners working on the economic evaluation of ecosystem services; the use of ecosystem services for poverty reduction or natural resource management have criticised the Millennium Ecosystem Assessment's (Millennium Ecosystem Assessment 2005) framework as too generic to meet specific needs. The results presented in Chapters Five and Six reinforce the need for a more nuanced approach to ecosystem services, especially with respect to the non-instrumental uses of ecosystem services.

Access to land is the single most used proxy for dependence on ecosystem services in many environment-migration studies. But the benefits gained from ecosystem services are not restricted to provisioning services and affective attachment plays an important role in creating utility. The results of Chapter Five showed that farming can be viewed in a positive light by farmers as an income source, in a negative light as a poor income source or as something more than an income source, a way of life. Chapter Six showed that neither remoteness, size of settlement nor access to off-farm labour markets predict the patterns of instrumental versus affective attachment to ecosystem services. Furthermore, someone with no access to land can form affective bonds to ecosystem services without being directly reliant on them for income, thereby extending the benefit gained from ecosystem services far beyond those with access to land or farming incomes and increase the population likely to be affected by environmental change.

7.4 Implications for Peru

The decision to move from a rural sending area of Peru cannot be taken out of the context of the wide range of research on rural issues: diversification of livelihoods, sustainability of the peasant lifestyle in a neo-liberal economic system, the positive or negative role of natural resources, degree of rurality. Peru is already a highly urbanized and centralized country with an expanding agricultural frontier. The highly motivated migrate to Lima for improved education and employment opportunities it offers; the more adventurous migrate to the jungle. Meanwhile the mining industry creates alternative migration flows to the sierra. Lima acts as a distribution centre for economic migrants from the provinces, meaning the migrants are not only found along the main access routes from their villages to Lima. However, the country is highly centralised meaning those seeking access to improved wages or better education opportunities only have one choice of destination.

The future of rural urban migration and whether it increases or decreases is inherently tied to the continuing viability of the rural smallholder lifestyle. This lifestyle has persisted despite market penetration into the area, and rural populations have remained stable despite high rates of out-migration. Climate change is unlikely to alter the patterns that exist, and that climate change might not be a greater challenge than pervious socio-economic changes that these populations

have shown the adaptability to cope with (Mayer 2001). What remains to be seen is whether there are limits to the adaptive capacity of these settlements. That is to say, whether climate change will be the external force that brings an end to the viability of the peasant lifestyle or whether the residents of these villages continue to show resilience to such changes (Adger, Dessai et al. 2009).

The highlands of Peru are the type of location where a standard assessment of climate change risks and vulnerability would predict climate change migration. There are highly visible climate change impacts and well-developed rural to urban migration flows. The results of the research presented here, however, present a different future for Peru and suggest a future of increased return migration from cities to these rural highland settlements and the increased sustainability of the rural lifestyle. Further dissatisfaction and a decrease in the wellbeing of the original residents of those settlements will likely accompany this increased sustainability.

This study has focused on the impact that long-term degradation in ecosystem services would have on every-day migration patterns driven by climate change, focusing in particular on the provision of water resources. A loss of glaciers may lead to increased seasonality of flows and lower dry season flows, but the research identified impacts of climate change that are more diverse and diffuse than a change in seasonality in stream flow in rivers. People in the field location had noticed changes in the timing and quality of precipitation, variability in the onset and duration of seasons, increased frequency of frosts and cold snaps and a decrease in snow cover and reduced duration of seasonal springs. Changes in precipitation regimes, required to maintain the flows of seasonal streams and refresh aquifers, are more important changes than the loss of glaciers.

Existing high levels of return migration and the precarious water supply situation in Lima suggest the most dominant form of environmental migration in Peru may be urban to rural return migration. As demonstrated in Chapter 6, in all settlements migrants compose a substantial portion of the population. In two of the settlements, the migrants are return migrants. In Peru, it is customary for a household to retain rights to land and property in their home villages as a security net when they migrate, leaving the possibility of return migration open. The destination for most migrants, due to the centralised nature of Peru is the capital city Lima.

Lima is located on a desert coast receiving only a few millimetres of precipitation a year. With a change in the seasonality of water provision because of reduced snowpack, disappearing glaciers and changing precipitation patterns, city dwellers may be most at risk. This suggests that environmental change has the potential to increase the volume of return migrants as conditions in the major urban areas deteriorate and the relative strength of push and pull factors alters. The

population in cities is less flexible with respect to obtaining natural resources, tied into systems of provision.

The results suggest that dissatisfaction related to natural resource provision in a rural setting can be overcome without migration – water can be bought from tankers, or transported from other locations by donkey, less crops can be planted in times of drought or farming work can be found on farms owned by other people. However, in the rural location dissatisfaction related to social drivers – obligations to family or a wish to send children to better schools- are inflexible and migration is not a choice. In Lima, the situation is reversed. Here there are opportunities for income, education and personal development but less flexibility with respect to gaining access to ecosystem services. Survey respondents in the villages often voice their low opinion of Lima in terms of having to pay for everything and if a person is hungry, there is no way to grow food to support yourself.

Whether people are moving down to Lima because of loss of ecosystem services, or from Lima back to the villages because of water supply shortages, they are moving within the same watershed. The implication is that migration to other departments of Peru in different watersheds, especially the mining centres and agriculture frontiers, may begin to receive more of the migrants from villages under pressure and that would have previously migrated to the coast.

By incorporating sense of place into place utility, changes in Peru which have previously only had a cultural significance now take on a significance in terms of migration. Orlove et al's (2008)'darkening peaks' represent not only the loss of cultural ecosystem services, but a loss of place utility and the potential for increased propensity for migration in the population.

The results of this research have implications for discussions on which groups will be the most vulnerable to climate change. In Peru, efforts focus on remote indigenous populations, and rightly so, since these groups are some of the most socially marginalised in the country. However, the results presented here require a broadening of the conceptualisation of the most affected by changes in the environment. Immigrants to an area and off-farm labourers were just as likely to gain utility from ecosystem services despite a lack of access to land. Given the importance of place attachment in mobility potential, these findings are important.

7.5 Contribution to theory

The original motivation of the work comes from the field of environmental change and human migration. New insights into the potential role of environmental change in migration came from integrating theories on wellbeing from ecosystem services with theories of individual migration decision-making. I implemented these theories using concepts and methods from the sense of place literature. This section discusses the contribution of findings of the thesis to these respective fields.

The findings show that the environment, through the idea of ecosystem services, can be conceptualised as a positive contributor to place utility. This research has shown that ecosystem services have a role in creating place utility and hence increase the attractiveness of a location in comparison to others. A reduction in ecosystem services affects migration flows by bringing people into a dissatisfied state, closer to their stress threshold and to migration. This is a different conceptualisation from that in the existing literature. Previous research has incorporated ecosystem services as the natural capital that allows people to migrate or helps them to adapt in location (Ruitenbeek 1996; McLeman and Smit 2006; Gray 2010; McLeman and Ploeger 2011).

The analysis carried out in Chapter Five demonstrates that information on attitudes and behaviour is easily incorporated into quantitative analyses. This model places self-reported drivers, barriers and sources of satisfaction at the centre of a quantitative analysis that allows such characteristics to be analysed alongside demographic and physical variables at multiple scales. Although the framework used in this research is not predicative, its methods are applicable to any population. The framework can be used to assess the place utility of the population and its mobility potential, in order to describe the current migration potential of the population and understand the kind of response that a degradation in place utility may produce.

The framework presented in this thesis differs from traditional demographic approaches in that it provides likelihood of future migration among a population based upon personal characteristics of the population. This is in contrast to approaches that look for correlations in past datasets between migration and some indicator of environmental degradation (Henry, Schoumaker et al. 2004; Gray 2010; Gray 2011). The approach has more in common with the kind of frameworks developed by McLeman and Smit (2006). Focusing on a ‘stayer’ population provides a different set of insights to looking at the characteristics of migrants, and are especially relevant as discussions of ‘trapped’ populations gain traction in discussions on population dynamics under environmental change (Foresight 2011).

A weakness of the research of the design is that I was unable to validate the model. I have no way of saying whether the individuals that the analysis identified as having low satisfaction, high mobility and mobility potential will actually be the first to migrate under environmental

degradation. This was a first attempt at creating and empirically testing an analytical framework on the environmental influence on migration that quantified affective characteristics and their interaction with environmental characteristics. In this first attempt at applying the framework empirically the results are only able to describe and characterise the population with respect to their propensity to migrate, but the variables and characteristics defined in this research are transferable to other research designs.

The research findings responds to the gap identified by Daw et al, (Daw, Brown et al. 2011) in that it disaggregates the benefits gained from the ecosystem. The research design acknowledges that the benefits of ecosystem services are not shared equally, that the same ecosystem service may be used differently by different groups and that a change in ecosystem services will affect different beneficiaries differently. The research finds that people gain utility directly from regulating services and that regulating services served to create sense of place of the population in that location.

In the rural location studied in this research where the economy no longer centres on agriculture, secondary and diffuse ecosystem services take on greater importance. The characteristics of the village from which people gained satisfaction, described in Chapter Five, relate to benefits specific to rural locations and their physical proximity to the natural environment, but are not directly tied to ecosystem services. The characteristics of life in the village that the population describe give a picture very similar to that of amenity migration to, for example, the Alps or Florida for the climate, access to the natural environment, recreational services and a slower pace of life.

Members of the population benefit from other people benefitting from the ecosystem services. Most importantly, traders are dependent on the trade that farmers generate, but also there are some people that enjoy the agricultural way of life surrounding them. Furthermore, extractive industries, although far removed from ecosystems and generally detrimental to them, rely heavily on water resources. In Peru, the mining industry is often in direct competition with farmers in the highlands over water resources.

In summary, individuals gain utility from non-provisioning ecosystem services independently of reliance on provisioning ecosystem services. Furthermore, provisioning ecosystem services providing important cultural services and the output of regulating services (clean air and a desirable climate) are rural amenities to which people form attachment. Farmers may have affective attachment to ecosystem services, or they main gain their utility from social and economic factors. Therefore, the impact of environmental change extends beyond those that depend on ecosystem services for their income while ecological place attachment becomes another intervening variable between farmers and migration.

The framework and approach applied in this thesis takes the principles and insights of behavioural migration theory and applies them to a very different migration setting from which they originally stemmed. Tying behavioural migration theory with ecosystem services leads to the concept of ecological place utility, the utility gained specifically from the ecosystem services in that location. Tying behavioural migration theory with place attachment provides a new way of implementing the concept of place utility and lead to the expansion of the definition of satisfaction to a broader definition of satisfaction, moving from residential satisfaction to wellbeing.

The drivers of dissatisfaction and barriers to migration that emerged from the analysis are consistent with established migration theory. A lack of income, a desire for a better income, lifecycle changes and a desire to improve human capital drive dissatisfaction. There is very little scope for environmental change to influence these drivers. The only way environmental change could influence drivers would be if lack of work or the desire to improve income drove dissatisfaction in the farming population. This is not a surprising finding to those that study migration, but is one that requires communication to the environmental change community. The framework instead suggests that environmental degradation affects the decision-making process by reducing place utility, and therefore altering the relative attractiveness of other options, or the relative size of the barriers to migration in comparison with staying.

This research integrates new thinking into the ideas of behavioural migration theory to gain new insights. A key contribution is the conceptualization of place utility in terms of place attachment. Wolpert (1965; 162) defines place utility as 'a positive or negative quantity, expressing respectively the individual's satisfaction or dissatisfaction with respect to that place.' The characteristics and strength of this utility can be investigated through the diverse ways in which people form attachment to place (e.g. Fresque-Baxter and Armitage 2012). In this thesis, the conceptualization of place utility creates a two-dimensional measure of utility, acknowledging the affective and instrumental bonds to place. The uni-dimensional measure of affective bonds to place used in this research (asking people what characteristics they liked about life in the village) provides only a superficial understanding of the ways people formed emotional attachment to place. However, it is successful in that it reveals the variety of ways in which people gain utility from place.

In order to investigate the contribution of ecosystem services to sense of place, the research created a method to determine the strength of attachment to some aspect of village life (see Chapter 5). A passive contributor to utility was something that respondents mentioned as a positive characteristic of life in the village. An active contributor to place attachment was a reason for not migrating if financial barriers were hypothetically removed.

Distinguishing between passive and active contributors to place utility contributes to the sense of place literature by providing a way to measure strength of attachment to place where traditionally researchers have used proxies such as length of residence. Active contributors to place utility are characteristics or qualities of location that make the population satisfied. Eighty nine per cent of the people that responded negatively to leaving if financial barriers are removed also answered negatively to having considered migration in their last period of residence.

7.6 Conclusion

This first application of the principles of ecosystem services to migration theory opens up analysis on the links between mobility and ecosystem services more generally. This thesis investigates the contribution of ecosystem services to place utility that in turn encourages people to stay in location. There are many other interactions between mobility and ecosystems and these interactions remain inadequately researched to date. The agricultural calendar and seasonal changes in the supply of ecosystem services drive patterns of cyclical migration. Many provisional ecosystem services are themselves mobile, for example, fish stocks. Furthermore, humans transport provisioning ecosystem services from where they are harvested to other locations for trade or consumption, teleconnecting the impacts of degradation in ecosystem services.

The thesis shows that the application of rigorous social science can greatly improve understanding of the links between climate change and migration. This research argues for an approach that applies relevant theories, takes into account work that has come before and uses an interdisciplinary approach. As shown in Chapter Two, research on the linkages between the environment and migration is highly under-theorised. The consistent application of theory may allow the community to begin to build a critical mass of comparable case studies. Furthermore, there is a huge body of theory on migration, natural capital and socio-ecological systems that has great potential to provide new insights on the relationship between the environment and migration. Often the environment and migration community fails to take into account existing work that has come before. There is a tendency to reinvent the wheel, or at least reinvent academic discussions that were put to bed decades ago. Much of the problem relates to the impermeability of disciplinary boundaries. This research attempts to build a framework drawing on the best from relevant but parallel fields and demonstrates the benefits of interdisciplinary work.

The framework and methodology used in this research are applicable to other locations. It is likely that it would produce similar results, that is, identify sub-populations of people that prefer to remain in apparently marginal environments with respect to income and people who want to leave but are unable to. It would be interesting to compare the differences in the proportions of the population in each mobility potential-place utility combination. However, in order to

understand how environmental degradation may influence future migration patterns, more information is required on personal stress thresholds. Are social barriers or financial barriers easier to overcome in the face of falling dissatisfaction? Who is more likely to move, a satisfied mobile person who begins to experience dissatisfaction or an immobile dissatisfied person who is pushed closer and closer to their stress threshold? An analysis of the migration decision-making process provides an understanding of propensity to migrate in the population. Without threshold information, it cannot identify *who* will leave first or *when*.

In the academic literature on the environment and migration, neo-Malthusian predictions of millions of climate refugees are effectively discredited. However, such narratives persist, particularly in policy discussions on adaptation to, and the security aspects of, climate change. This in turn has lead to the adoption of polices, which guide the allocation of resources, based on a narrative completely at odds with reality and with the body of evidence presented by the academic community. Perhaps the academic community is to blame for not disseminating its research effectively. However, I believe this lack of acknowledgement of the evidence relates to the emotive nature of migration and the potentially serious implications for population dynamics and national sovereignty. Climate change is easily appropriated by diverse interests in order to achieve otherwise unpopular objectives such as population resettlement.

There is a refusal, in both academic and policy circles, to accept what is in front of our eyes. Climate change impacts and adaptation schools talk about climate impact 'hotspots', but the reality is that there are innumerable locations across the world where people have to cope with environmental degradation and hazardous and unpredictable climates. Sometimes this is because of the other benefits such a place offers; in other locations, it is the result of social marginalisation. The majority of the population does not have the inclination or the capacity to migrate. People in already difficult situations find a way with lives that are becoming harder and harder and raise stress thresholds in order to carrying on coping. Migration is the domain of the most fortunate; lack of choice characterises poverty.

This empirical investigation was designed, in part, as a reaction to alarmist estimates of climate change refugees. Whilst others' reaction to those unfounded claims was to apply the quantitative methods of demography and looked for correlations in the data, my approach in this thesis is based in theory, and the insights that decades of migration research contribute. Notwithstanding the differences in approach, both are concerned with understanding differentiation among and between populations in migration potential under environmental change.

There is a quote, attributed to Ernest Rutherford (a founding father of nuclear physics), that the only possible conclusion the social sciences can draw is: some do, some don't. However, if our goal is to help populations whose quality of life is most at risk from environmental change, then that is *exactly* what we need to understand with respect to migration: who does and who does not, who can and who cannot, who wants to and who does not. However, more importantly, we can determine *why* these groups show certain characteristics. This is what allows us to understand how migration patterns will evolve under future environmental change and to plan the implementation of more realistic solutions.

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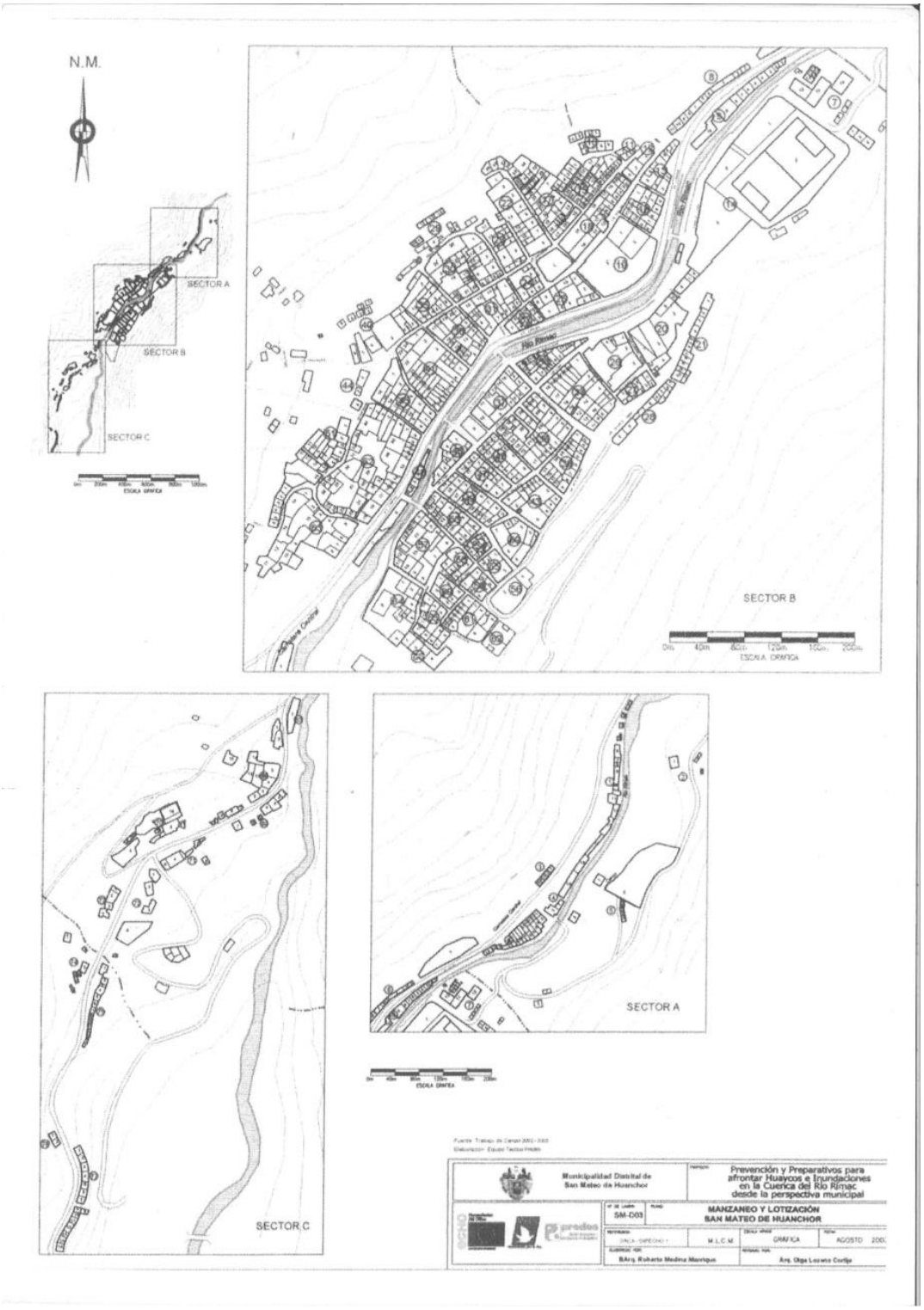
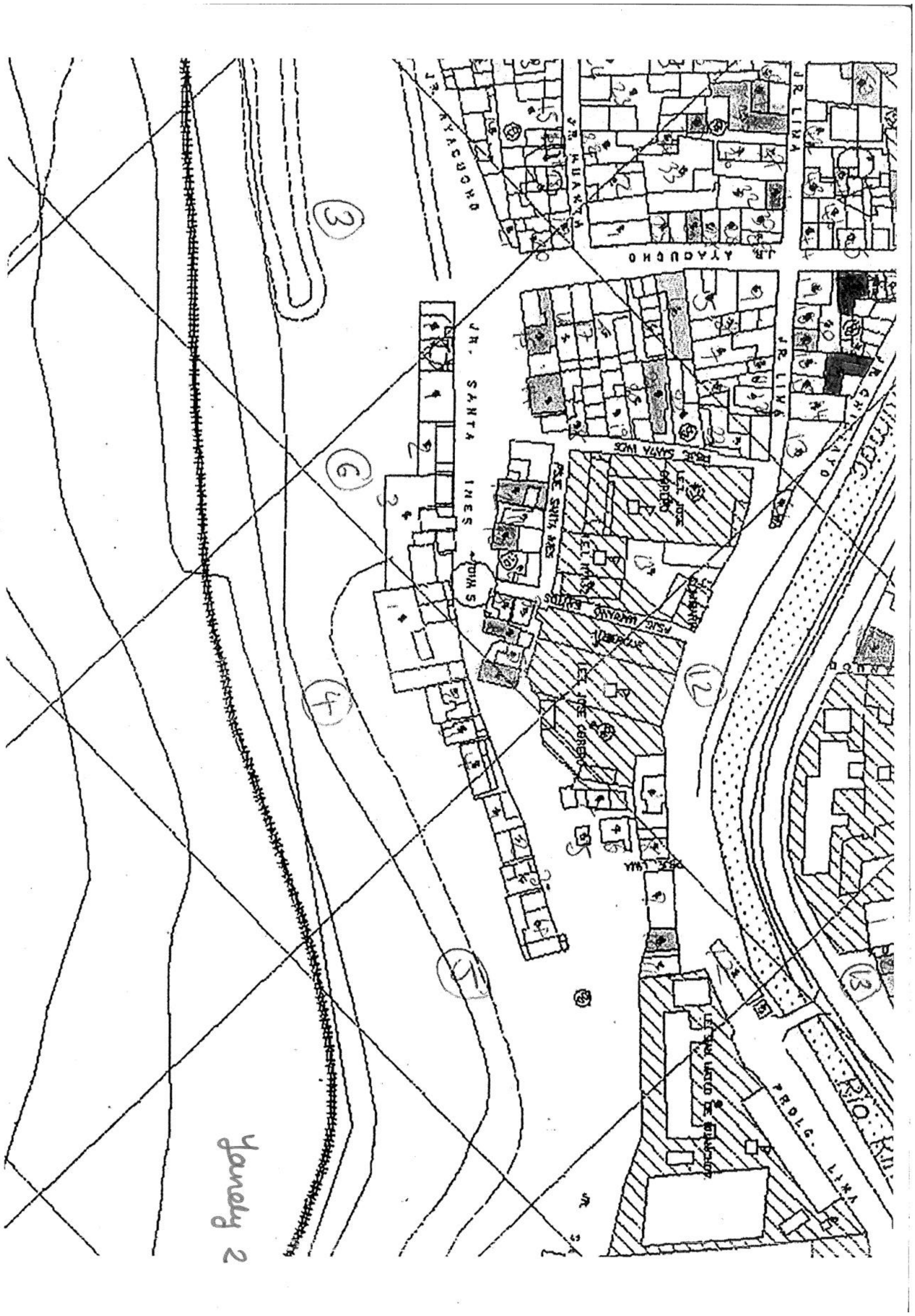
9 Appendices

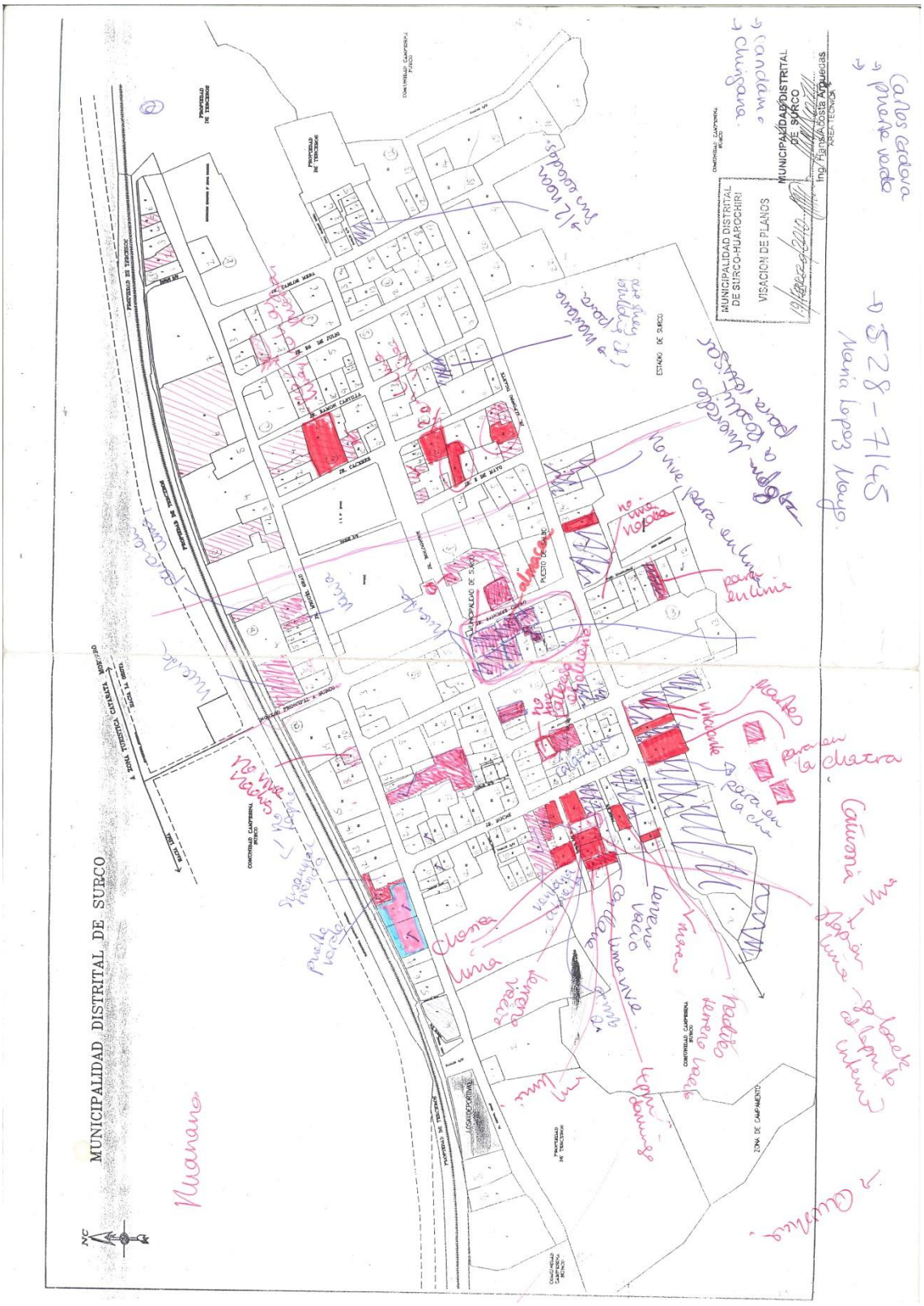
9.1 1: Examples of town plans used to create sampling frame



Town plan of San Mateo, this plan (in A3) was used to number the households.



Detail of part of San Mateo showing the sectors number, and the houses within the sectors given individual numbers



Surco town plan, with field notes. Actual map A3 in size.

9.2 2: Survey

The following pages present the survey as used in the field.

Encuesta 'Cuánto y por qué le gusta a usted su lugar' (en relación con el medio ambiente)

Preguntas sobre el uso de agua, la migración, acciones en tiempos de escaso y cambios en la calidad de vida.

Fecha:		Entrevistados:		Teléfono:	
Pueblo:				Dirección:	
Código:					

Entrevistador			Revisado por entrevistador?	No	Sí
HA estuvo?	No	Sí	Revisado por HA?	No	Sí
Completo?	No	Sí	Datos en Excel?	No	Sí

Usted tiene su chacra? Sí ☐ No ☐ *Si no, ve a pregunta 1b. Si sí, ve a pregunta 1c.*

Por qué no tiene? _____

Que cultivos se puede sembrar y en qué mes?

Cultivo	Siembra	Cosecha

Usted tiene su pasto? Sí ☐ No ☐ *Si no, ve a pregunta 2b. Si sí, ve a pregunta 2d.*

Por qué no tiene? _____

Usted tiene sus animales? Sí ☐ No ☐ *Si no, ve a siguiente pagina. Si sí, ve a pregunta 2d.*

Qué animales y cuántos?

Animal	Cantidad

Por qué no tiene más animales? _____

Para los que tienen su chacra/pasto: *Si no tiene, ve a pregunta 4*

Tiene riego en la época de secas?	Sí ☐ No ☐ *Si no, ve a pregunta 3f. Si sí, ve a pregunta 3b.*
Hace cuánto tiempo ha tenido riego?	Siempre ☐ o Hace _____años
Qué tipo de riego tiene?	_____ *Inundación, aspersión*
De qué fuente(s)?	_____ *manantial, riachuelo, rio, lago* *Si reservorio, pregunta con que agua llenan el reservorio*
En la época de seca este fuente….	Baja? ☐ Se seca? ☐ No cambia? ☐
Siempre tiene suficiente agua para sus cultivos?	Sí ☐ No ☐ *Si no, ve a pregunta 2h. Si sí ve a pregunta 3.*

Ej. cuando se rompió la sistema de riego o las lluvias vienen tarde, o el agua baja mucho

Cómo? Cuándo? Cuénteme un poco más por favor…	_____ _____
Y que hace en estas situaciones para tener suficiente agua?	_____
Y si la situación fuera peor, que haría?	_____

Para todos:

Usualmente, cuándo empieza y termina el época de lluvias?	Empieza: Termina:
De dónde viene el agua que usa en su casa? Es decir el agua de los caños es de…	_____ _____ *manantial, riachuelo, rio, lago*
En la época de seca el agua de su caño….	Baja? ☐ Se seca? ☐ No cambia? ☐
Tiene un idea de la cantidad de agua que usa en su casa diario?	Sí ☐ ____ litros No, no tengo ni idea ☐
Siempre tiene suficiente agua para tomar, lavar, cocinar?	Sí ☐ No ☐ *Si no, ve a pregunta 4e. Si sí ve a pregunta 5a*

Ej. Cuando están haciendo mantenimiento, cuando agua en red no llega a su casa, sequias grandes en el pasado

Cómo? Cuándo? Cuénteme un poco más por favor…	_____ _____
Y que hace en estas situaciones para tener suficiente agua?	_____ _____
Y que pasaría, si la situación fuera peor?	_____ _____

Qué tipo de casa tiene?	☐ Casa independiente ☐ Departamento en edificio ☐ Vivienda en quinta ☐ Choza o cabaña	☐ Vivienda improvisada ☐ Vivienda en casa vecindad (callejón, solar, corralón) ☐ Otros: _____
De qué material es el techo?	☐ Concreto armado ☐ Madera ☐ Tejas ☐ Planchas de calamina	☐ Caña o estera con torta de barro ☐ Estera ☐ Paja ☐ Otros: _____
De qué material son sus paredes	☐ Adobe/Tapia ☐ Madera ☐ Estera ☐ Quincha (caña con barro)	☐ Ladrillo/Bloque de cemento ☐ Piedra o sillar con cal o cemento ☐ Piedra con barro ☐ Otros: _____
De qué material es el piso?	☐ Parquet o madera pulida ☐ Madera (entablado) ☐ Cemento ☐ Tierra	☐ Losetas, terrazos o similares ☐ Láminas asfálticas, vinílicos o similares ☐ Otros: _____
Cuál es el tipo de alumbrado?	☐ Electricidad ☐ Vela ☐ Petróleo/gas (lámpara)	☐ Kerosene (mechero/lámpara) ☐ No tiene ☐ Otros: _____
Cuál es el combustible que más utiliza para cocinar?	☐ Electricidad ☐ Gas ☐ Carbón ☐ Leña	☐ Kerosene (mechero/lámpara) ☐ Bosto o estiércol ☐ Otros: _____
El agua que usa en su vivienda procede de	☐ Red pública conectada dentro de la vivienda ☐ Red pública conectada fuera de la vivienda ☐ Cisterna/camión	☐ Pozo ☐ Río/Acequia/canal/manantial ☐ Pión de uso publico ☐ Otros: _____
Cómo es el servicio higiénico (wáter, excusado, letrina) en su casa?	☐ Red pública conectada dentro de la vivienda ☐ Red pública conectada fuera de la vivienda ☐ Letrina/Pozo ciego	☐ Pozo séptico ☐ Río, acequia o canal ☐ Otros: _____

Qué cosas le gusta a Usted sobre la vida acá? _____

_____

Qué cosas no le gusta a Usted sobre la vida acá? _____

_____

En una escala de 1 al 7, cuanto le gusta vivir acá?

No mucho						Muchísimo
1	2	3	4	5	6	7

Alguna vez ha salido y ha regresado? Sí ☐ No ☐ *Si no, ve a pregunta 9a. Si sí, ve a pregunta 8b*

Por qué salió? _____

Por qué regresó? _____

Alguna vez ha pensado en salir de acá? Sí ☐ No ☐ *Si no, ve a pregunta 10a. Si sí, ve a pregunta 9b*

Si sí, por qué? _____

_____

Si lo pensó, por qué no salió? _____

_____

Cuáles fueron los obstáculos e impedimentos?

Si tuviera el dinero, se iría Usted mañana? Sí ☐ No ☐

Por qué? _____

_____

Cómo es la vida acá, mejor peor o lo mismo que antes: Mejor? ☐ Peor? ☐ Lo mismo? ☐

Por qué? _____

Si no tuviera su chacra o sus animales, se iría? Sí ☐ No ☐

Por qué? _____

Pensaría en regresar a la vida de la chacra? Sí ☐ No ☐

Por qué? _____

14a. Información sobre cada **ADULTO** (más de 16 años) que vive en su casa la mayoría del tiempo

Nombre	**Relación**	**Sexo**	**Edad**	**Nivel de educación**	**Trabajo**	**Donde nació?**	**Ha salido de y regresado a este pueblo?**	**Cuando llegó en este pueblo?**	**Porque vino acá?**
Nombre nomas, no necesitamos apellido	*Jefe/jefa; esposo/a; hijo; otra relación; otra persona*	*Masculino o femenino (M o F)*	*Edad en años*	*Primario o Secundario y año (ej. S1), o superior*	*Niños/casa , escuela, chacra, ganadería, piscigranja, gobierno, empresa (ej. Mina, fabrica), pequeño negocio (ej. vender/lavar)*	*Pueblo, distrito, provincia*	*Sí o no*	*Hace cuantos años – ultima vez*	*Ej. Estudiar, estudiaba y no regresó, se casó, trabajo, trabajo de esposo,* *O por qué regresó…*

14b Cuántos niños viven en la casa? _____

14c De qué edades? _____

Tiene hijos adultos que no viven en casa? Sí ☐ No ☐
Si no, ve a pregunta 2. Si sí, ve a pregunta 1b

Cuántos viven acá en el mismo pueblo? _____

Cuántos viven en otros lugares? _____

Dónde viven? En qué pueblos/ciudades _____
_____

Tiene hermanos? Sí ☐ No ☐
Si no, ve a pregunta 3. Si sí, ve a pregunta 2b

Cuántos hermanos viven acá en el mismo pueblo? _____

Cuántos viven en otros lugares? _____ *Si sí, completa el cuadro abajo*

Dónde viven? En qué pueblos/ciudades? _____
_____

Cuántos todavía viven en el lugar de nacimiento *(si esta persona no ha nacido acá?)* _____

Nos gustaría hablar con el último hermano en irse (o con un hermano que tiene disponibilidad hablar con nosotros) que vive en Lima o este valle. Puede dar nos su teléfono y dirección para que podamos buscarlo? También, sería muy útil si puede avisarlo que vamos a llamar.	Nombre: Tel. fijo: Móvil: Dirección:

Cuántos veces se ha mudado esta familia? *Es decir en cuantos lugares diferentes ha vivido?* _____

Cuántos veces se ha mudado el jefe del casa antes de casarse? _____

Cuántos veces se ha mudado su esposa antes de casarse? *(si hay una esposa…)* _____

Algunas personas en su casa tiene más de un trabajo? A veces o siempre?

Sí ☐ No ☐ *Si no, ve a pregunta 3a. Si sí, ve a pregunta 1b.*

Si tienen otro trabajo, que tipo de trabajo, y con qué frecuencia?

Ej. Siempre se dedica a dos trabajos, a veces cuando necesita comprar algo, cada dos semanas, cuando no hay lluvia, cuando las cosechas se malogran …

Quién?	Qué trabajo?	Con quéfrecuencia?

Parte 3: Cambios en el pasado

Antes se cultivaba lo mismo en los chacras?

Sí ☐ No ☐ *Si no, ve a pregunta 19b. Si sí, ve a pregunta 20a*

Qué diferencias hay?

Porque hay estas diferencias?

Hace cuánto tiempo empezaron los cambios?

Y cómo le ha afectado?
Ej. Ahora tiene que tener más animales, no hay una razón para los jóvenes quedarse…

Qué eventos extremos en el clima afectan su vida? Cómo?
Ej. Heladas, sequias, fuerte lluvia, huaycos, nieve, fuerte viento, cambios en las estaciones

Evento	Cómo cambia su vida?

Ha habido cambios?

Los mismos ☐ Cambios ☐ *Si los mismos – ha terminado. Si cambios ve a pregunta 20c*

Qué cosas han cambiado y cómo? *(de los eventos en el cuadro arriba)*

Ej. más frecuencia, menos frecuencia, mas fuerte, menos fuerte, más duración, menos duración, antes no había pero ahora sí, antes había pero ahora no…

Y cómo le ha afectado?

9.3 3: Selected output of logistic regression

Selected output for the logistic regression ran on the variable considered_migration the results of which are presented in Section 4.2.2.

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	418	96.5
	Missing Cases	15	3.5
	Total	433	100.0
Unselected Cases		0	.0
Total		433	100.0

a. If weight is in effect, see classification table for the total number of cases.

Categorical Variables Codings

		Frequency	Parameter (1)
Do they have kids 16 and under living in the house?	No	147	1.000
	Yes	271	.000
Male or female	Male	168	.000
	Female	250	1.000
Farmers	0	280	.000
	1	138	1.000
Does the person or their partner usually work away?	No	364	.000
	Yes	54	1.000

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	60.184	9	.000
	Block	60.184	9	.000
	Model	60.184	9	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	516.834[a]	.134	.179

a. Estimation terminated at iteration number 4 because parameter

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	6.741	8	.565

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for	
							Lower	Upper
Age	-.024	.010	5.675	1	.017	.976	.957	.996
Edu	.232	.074	9.902	1	.002	1.261	1.091	1.457
Time_stable	-.001	.007	.035	1	.852	.999	.986	1.012
EMPLOYED_AWAY(1)	1.000	.372	7.238	1	.007	2.718	1.312	5.631
Children_Lima	.017	.082	.042	1	.837	1.017	.866	1.194
Sex(1)	.411	.233	3.121	1	.077	1.508	.956	2.379
Farmers(1)	.492	.229	4.636	1	.031	1.636	1.045	2.562
MINORS(1)	.005	.300	.000	1	.988	1.005	.558	1.810
DEPENDENCY_RATIO	-.145	.437	.111	1	.739	.865	.368	2.035
Constant	.048	.585	.007	1	.935	1.049		

a. Variable(s) entered on step 1: Age, Edu, Time_stable, EMPLOYED_AWAY, Children_Lima, Sex, Farmers, MINORS, DEPENDENCY_RATIO.

Casewise List[b]

Case	Selected Status[a]	Observed	Predicted	Predicted Group	Temporary Variable	
		Have you ever			Resid	ZResid
123	S	0**	.868	1	-.868	-2.560
401	S	0**	.909	1	-.909	-3.166

a. S = Selected, U = Unselected cases, and ** = Misclassified cases.

b. Cases with studentized residuals greater than 2.000 are listed.

9.4 4: Spanish versions of quotes used in Chapters Four and Five

Examples in Spanish	English translation of examples
• Cuando acaba mi hijo su colegio para su superior, tengo que salir para atender (221)	• When my son finishes school I've got to leave to look after him (221)
• Para conocer o conseguir algo mejor (290)	• To know or achieve something better (290)
• Por la superación de mis hijos, que sean algo en la vida y no se queden como yo (302)	• For the betterment of my children, so that they can be something in life and not stay here like me (302)
• Por superación de mi hijo y de mí mismo (341)	• For the betterment of my son and myself (341)
• Por trabajo, porque acá no hay trabajo (297)	• For a job, because there are no jobs here (297)
• A veces acá no hay ingresos (275)	• Sometimes here there's no income (275)
• Eran enfermedades en las chacras, más gastos (353)	• There were diseases in the farm, additional spending (353)
• Por falta de dinero, para trabajar (419)	• For lack of money, to work (419)
• Para vivir con mi hija y estar a su lado (339)	• To live with my daughter and be with her (339)
• Ya mi esposo me dejó (26)	• My husband left me (26)
• Pienso salir por mi edad para hacerme curar (185)	• I would like to leave because of my age and recover my health (185)
• Acá he tenido problemas con mi familia (264)	• I had had problems here with my family (264)
• Cuando no pueda trabajar la chacra (289)	• When I am not able to work in the chacra anymore (289)
• Regresar a mi pueblo (13)	• To go back to my village (13)
• Porque mi hija se fue a estudiar y yo creía que en Lima le iba a pasar algo (158)	• Because my daughter went to study to Lima and I thought that something bad could happen to her (158)
• Siempre pienso que la vida en otros países es mejor (73)	• I always think that life in other countries is better (73)
• Pienso trabajar en otro sitio para ganar mejor y darle a mis hijos. Aquí pagan poco dinero y no alcanza (219)	• I think about working in another place to earn better and support my children. Here they pay you little money and it's not enough (219)
• Para tener un ingreso mejor para mi familia (41)	• To have a better income for my family (41)
• Para hacer mi negocio en Lima (204)	• To start a business in Lima (204)
• Donde hay más comercio (146)	• Go where there's more business (146)
• Acá solo tengo cachuelos y en Huancayo mi papá tiene su casa, ahí pondría mi negocio (412)	• I've only got only day labour here and in Huancayo I could start a business in my dad's house (412)
• Por hacer negocio, sembrar arroz, maní, en la selva (320)	• To do business, grow rice and peanuts in the jungle (320)
• Por negocio, acá no hay negocio (284)	• For business, there's no business here (284)
• Una aventura, aventarse (283)	• For the adventure, to take the risk (283)
• Vivir en otro lugar ya (239)	• To live in another place soon (239)
• Porque quiero conocer a otros sitios (335)	• Because I want to see other places (335)
• Mucha corrupción (139)	• Too much corruption (139)
• Porque era joven, diversión (287)	• Because I was young, looking for fun (287)
• Por el clima, acá hace frio (389)	• Because of the climate, it's cold here (389)
• Por mi flaca me voy a Chosica (165)	• I am going to Chosica because of my girlfriend (165)

Table 4.3

Examples in Spanish	English translation of examples
• No tengo casa, ni trabajo, por eso no salgo (175)	• I don't have a house, nor work [in Lima], that's why I don't go (175)
• Falta de recursos económicos, todo es plata en Lima. Si no tienes una propiedad, tienes que pagar alquiler (213)	• Lack of money, everything is money in Lima, and if you don't have a property you've got to pay to rent a place (213)
• Todavía no tenemos suficiente dinero para comprar una casa en otro sitio (210)	• We don't have enough money yet to buy a house in another place (210)
• No tengo terreno para una casa para vivir (34)	• I haven't got the land to build a house to live in (34)
• No tengo suficiente dinero y no encuentro trabajo estable (304)	• I haven't got enough money and I can't find stable job (304)
• Por mi mamá, tengo que dedicarme a mi mama (168)	• Because of my mum, I've got to look after her (168)
• Por mi mamá, ella no se acostumbra en otros lugares (228)	• Because of my mum, she can't get used to it in other places (228)
• Por no dejar a mi esposa y a mis hijos (134)	• So that I don't have to leave behind my wife and children (134)
• Acá tengo mi casa si me iba como se quedaba mi otro hijo, porque en lima se hace mucho gasto si le llevaba también a mi hijo (158)	• I've got my house here, if I'd gone how could my other son stay on his own? It would be too expensive to take him to Lima too (158)
• No hay con quien dejar mis hijos no es como una modelo madre (219)	• There isn't anybody to leave my children with, there is no replacement for a mother (219)
• No hay con quien dejar a mis animales y mi casa (217)	• There isn't anybody to leave my animals and my house with (217)
• Mi mujer no quiere irse de aquí, quiere estar cerca a su familia. Ella es de Huarochirí (412)	• My wife doesn't want to leave this place, she wants to be close to her family. She's from Huarochirí (412)
• Por falta de decisión de Héctor, quiere vivir toda la vida al lado de su mamá (24)	• Because Hector doesn't have the courage He wants to spend his whole life at his mum´s side (24)
• Por mis terrenos, no salgo (365)	• I don´t go away because of my land (365)
• Por el negocio (201)	• Because of my business (201)
• Por motivo de trabajo, acá hay minería pero en otros sitios no hay trabajo (87)	• Because of my job, there´s mining here but in other places there aren't any jobs (434)
• Por su trabajo de mi esposo. En Huancayo no hay mina (434)	• Because of my husband´s job. There´s no mine in Huancayo (434)
• El trabajo de mi hija y el estudio de mi nieta (115)	• My daughter´s job and my granddaughter´s studies (115)
• Están todavía estudiando en el colegio. Cuando salgan…(441)	• They [my children] are still studying at secondary school. When they graduate... (441)
• Todavía están estudiando, terminarán y se va, si no, no tienen futuro (246)	• They're still studying, they'll finish and they're off, if not they don't have a future(246)
• Estoy esperando que mi hijo acabe de estudiar (335)	• I'm waiting for my son to finish school (335)
• Por no dejar a mis padres, me da pena (30)	• So as not to leave my parents, I miss them (30)
• Por miedo y temor de ir sola (297)	• For fear and being afraid to go alone (297)
• Acá tenemos muchos recuerdos de mamá (398)	• There are lots of memories of our mum here (398)
• No te acostumbrarías en otro lugar (439)	• You would never get used to it in another place (439)
• Tengo miedo que la gente robe mis cosas (285)	• I'm afraid that people will steal my things [while I'm away]
• Por falta de decisión aún no me he decidido (351)	• Due to lack of decision, I still haven't decided (351)
• Me quedé por…no te puedo decir…no me sentí… salir lejos solo es difícil (275)	

• Ya me acostumbré en San Mateo (425)	• I stayed because...I couldn't tell you...I didn't feel...it's hard to leave on your own (275) • I'd got used to San Mateo (425)
• Pienso que en otro lugar también sería igual o peor (152)	• I think it'd be the same or worse somewhere else (152)
• En otro lugar muchas cosas que están pasando. Secuestros, hasta matan por 10 soles (126)	• Lots of bad things happen in other places, kidnappings, they even kill for 10 soles (126)
• Ahora acá me están ofreciendo trabajo, por eso me quedo (155)	• They're offering me work here now, so I stay (155)
• Empecé a trabajar acá y cambié las ideas, quizás más adelante (327)	• I started to work here and changed my mind. Perhaps in the future (327)
• Ya mi esposo se vino para acá y nos va más o menos bien (114)	• In the end my husband came here and we're doing more or less okay (114)
• Pero ellos se casaron muy rápido y se fueron (118)	• They got married [his children] really quickly and left (118)
• Porque todavía no tengo esta posibilidad (27)	• I haven't had the opportunity yet (27)
• Todavía no sé dónde ir, sí, estoy pensando… (65)	• I don't know where to go yet, yes, I'm thinking (65)
	• I already told you, because of my health (124)
• Ya le dije, por mi salud (124)	•
• Está embarazada (19)	• She's pregnant (19)
• Ya estoy viejo, ya tengo una vida acá (300)	• I'm old now, I've got a life here (300)
• Yo vendo mi chacra y ya me voy (336)	• As soon as I sell my farm, I'm off (336)
• Estoy esperando que mi hijo termine su colegio este año y nos vamos (417)	• I'm waiting for my son to finish school this year and then we're leaving (417)
• No, de acá 2 o 3 años ya me voy, voy a extrañar mi pueblo, pero así es la vida (345)	• No, in two or three years I'm leaving, I'm going to miss my village, but that's life (345)
• No quería tanto salir (10)	• I didn't feel like leaving (10)

Table 4.4

Examples in Spanish	English translation of examples
• Este sitio es muy hermoso (134)	• This location is really beautiful (134)
• El clima, el sitio ecológico, las plantas, la naturaleza (51)	• The climate, the pristine environment, the plants, the nature (51)
• El clima es un poco más templado que en Pacota (12)	• The climate is a bit milder than in Pacota (12)
• Es tranquilo, me distraigo bastante ir a la chacra, ir a ver como están las plantas (242)	• It's quiet, I enjoy going to the chacra, going to see how the plants are doing (242)
• Todo Surco es muy hermoso, sobre todo sus paisajes (379)	• Everything in Surco is really lovely, especially the scenery (379)
• Aire libre es bueno para la salud (387)	• Fresh air is good for your health (387)
• Su clima limpio y fresco, en Lima respiras humo y combustible (331)	• The environment is clean and fresh, in Lima you breath smoke and fumes (331)
• Bastante agua, cerca del río, pescar, salir al campo, clima sano (200)	• Lots of water, close to the river, can go and fish, head to the countryside, clean environment (200)
• Nos conocimos unos a otros (73)	• We know each other (73)
• Vecinos, personas que me gustan, la gente es más suelta (167)	• Neighbours, the people that I like, people here are more easy going (167)
• Estar juntos con mi hijo, ayudar en sus tareas (164)	• Being close to my son and be able to help him with his homework (164)
• Ir a los eventos deportivos, festividades (253)	• Going to sporting events and village celebrations (253)
• La libertad de andar en las calles sin miedo, sin que nada te pase (341)	• The freedom to walk in the streets without worrying that something might happen to you (341)
• Tranquilo, no hay delincuencia (82)	• It's safe, there's no crime (82)
• Trabajo que hay, más ambiente para el negocio (118)	• There are jobs, a better environment for business (118)
• Hay trabajo en la mina (410)	• There's work in the mine (410)
• Mi trabajo, gano bien (78)	• My job, I earn well (78)
• Trabajar, mucho trabajo (253)	• Working, there's lots of work (253)
• Cerca a los trabajos (159)	• Being close to work (159)
• Los atractivos turísticos (348)	• The tourist attractions (348)
• No cuestan mucho las casas (191)	• Houses don't cost a lot (191)
• Parque, iglesia antigua (275)	• The park, and the old church (275)
• Estadio deportivo (219)	• The sports stadium (219)
• Más distraído, más cosas hacer (11)	• More entertainment, more things to do (11)
• Estamos cerca a la capital y nos movilizamos con rapidez (398)	• We're close to the capital and can get around easily (398)
• la tranquilidad, no hay gente que hace bulla, es silencio (202)	• The peace and quiet, there isn't anybody making a racket (202)
• La tranquilidad, la paz (181)	• The tranquillity, the peace (181)
• Todo, por eso me he quedado (305)	• Everything, that's why I've stayed (305)
• El sitio y el lugar, todo me gusta (99)	• The village and its location, I like everything (99)
• Mi pueblo, he nacido acá, acá moriré, estoy acostumbrado (250)	• My village, I was born here and I'll die here, I'm used to it here (250)
• Es mi tierra (178)	• It's my homeland (178)
• Las chicas! (280)	• The girls! (280)
• Es el sitio donde se puede salir adelante, tiene casi de todo (274)	• It's a place where you can progress, it's got almost everything (274)
• Iglesia y gente Cristiana (222)	• The church and Christian people (222)

Table 5.1

Example
When asked about what they like about where they live: "Vivir con mis animales en el campo" (33) "Living with my animals in the countryside" (33) "Ir a la chacra con mis animales. Criar cuyes" (34) "Going to the fields with my animals, raising guinea pigs" (34) "La clase de trabajo, los animales" (35) "The type of work, the animals" (35) "Vivimos todos de la vaca, porque sacamos leche, queso" (36) "We all live from the cows, because we milk them, make cheese" (36) "No se acostumbra, no quiere cocinar con gas, prefiere con leña" (35) "She can't get used to it, she doesn't want to cook with gas, she prefers to cook with firewood" (35). The field assistant wrote as the reason for her not wanting to leave if she had the money – who was the person, how old where they and where did they live? Non-farming households can keep a chacra even though it does not provide much benefit financially, for the tradition and to give the younger generation the knowledge. Vestiges of pre-Spanish religion structured around the natural world remain in Catholic celebrations. Crosses are placed on surrounding hilltops and brought down and celebrated. In some regions, crosses are put on top of the hills for each of the different irrigation districts. "Su paisaje que te distrae, lindo, te relaja" (304). "The scenery that takes your mind off things, it's lovely, it relaxes you" (304) "Surco es muy bonito no lo cambio por nada (377) "Surco is really nice, I wouldn't change it for anything" (377) "ya me pongo triste a ver que eso está pasando" (162) "It makes me sad to see what is happening" (162) when answering how changes in the climate affected her. "Actualmente me preocupo porque la gente no sabe cuidar el medio ambiente, cortan los arboles pero no siembran para el futuro" (94) "I'm actually worried because people don't know how to look after the environment. They cut down trees but don't plant any for the future" (94) when answering how changes in the climate affected him. Although they themselves aren't involved in agriculture: "Los que siembran las alfalfas" (136) "That people grow alfalfa" (136) "Los animales que hay en el campo" (131) "The animals in the countryside" (131)

Table 5.3

9.5 5: Data tables for analysis of villages in Chapter 6

	% of the population exhibiting characteristic			
	Chocna (n=21)	Caruya (n=16)	San Mateo (n=227)	Surco (n=169)
Past migration				
Non-migrants	20	19	22	33
Return migrants	50	25	21	44
Immigrants	20	38	41	19
Return immigrants	10	19	16	5
Current mobility				
HHs away	10	25	12	14
Kids outside village/household adults	1.27	0.86	0.69	0.85
Future mobility potential				
Average age	48	42	43	47
Secondary education	48	81	70	58
Average time stable	34	21	21	29
Importance of labour migration				
Labour migration	30	25	35	29
Temporary migration (migration to stay)	10	13	20	26
Labour related immigration	80	63	73	45
Individual satisfaction and attachment to place				
Satisfaction				
Population that had considered migration	38	56	54	55
Average score on satisfaction scale	6 (2)	5 (2)	5 (1)	5 (2)
Contributors to place attachment				
Environment and climate	76	94	51	64
Friends family and social events	5	0	26	16
Safe/uneventful	0	13	25	14
Work related	10	6	14	2
Services and amenities of the town	10	0	10	11
Peace and tranquillity	5	13	7	8
Emotional attachment	5	0	7	12
Ecologic place attachment				
Climate	20	19	37	47
Farming	60	50	5	17
Lack of pollution	5	38	11	14
Aesthetic value	19	38	10	10
Socio-ecological characteristics of the settlement				
Use of provisioning ecosystem services				
Ecological zones used	3	3	4	5
Access to land	91	94	27	86
Farming only households	71	27	4	44
Mixed farming and non-farming	10	67	25	41
Services				
Secondary school	No	No	Yes	Yes
Hours to Lima (very approx.)	7	5	4	2
Number of job types	6	7	27	23
Dependency ratio	0.56	0.46	0.40	0.60
House material poor	33	31	15	21

9.6 6: Calculations for ternary diagram

An online Excel spreadsheet was used to plot the data on the ternary diagram produced by Will Vaughan at Brown University: www.w**vaughan**.org/ternary-plot.xls. The table below shows the data that were input into the Excel spreadsheet.

Ecosystem services **Mixed-income** **Non-movers**	**Social & emotional** **Farm** **Return migrants**	**Place preferences** **Off-farm** **Immigrants**	**Settlement/ characteristic**	**X**	**Y**
69	9	22	Ch-PU	19	19
75	0	25	C - PU	13	22
36	24	40	SM - PU	44	34
50	22	27	S - PU	36	24
10	71	19	Ch - farm	81	16
67	27	7	C - farm	30	6
25	5	70	SM - farm	40	61
41	44	15	S - farm	51	13
19	52	29	Ch - migr	67	25
19	25	56	C - migr	53	49
22	20	57	SM - migr	49	50
33	44	24	S - migr	56	20

Since place utility data for each town took the form of the percentage of the population that had mentioned a specific characteristic, the data were normalised to 100. The raw data and normalised data are provided in the table below. The characteristics of dependence on farming and migration history of the individual were tri-variate and already normalised to 100.

	Dimension of place utility	**Chocna**	**Caruya**	**San Mateo**	**Surco**
Actual values (%)	Ecosystem services	76	94	51	64
	Social & emotional	10	0	33	28
	Place preferences	24	31	55	35
Values normalised to 100	Ecosystem services	69	75	36	50
	Social & emotional	9	0	24	22
	Place preferences	22	25	40	27

9.7 7: Cross-tabulation used to implement the decision-tree model

Whole sample

Ecologically place dependent	Ecologically place attached	Satisfied	Mobile	High mobility potential	Count	Table N %	Decision group No.	% of pop. in decision group	Response
No	No	No	No	No	29	6.7	1	31	Migration not affected by changes in ecosystem services
				Yes	26	6.0			
			Yes	No	6	1.4			
				Yes	11	2.6			
		Yes	No	No	46	10.7			
				Yes	2	0.5			
			Yes	No	10	2.3			
				Yes	2	0.5			
	Yes	No	No	No	41	9.5	2	16	Raise stress threshold
				Yes	27	6.3			
			Yes	No	9	2.1	3	2	Raise stress threshold
				Yes	10	2.3	4	2	Permanent migration if place utility falls sufficiently to overcome barriers
		Yes	No	No	53	12.3	5	13	Dissatisfaction generated
				Yes	4	0.9			
			Yes	No	12	2.8	6	3	Dissatisfaction generated
				Yes	3	0.7		1	Dissatisfaction generated and increased likelihood of migration
							7		
Yes	No	No	No	No	8	1.9	8	4	Raise stress threshold
				Yes	8	1.9			
			Yes	No	2	0.5	9	0	Raise stress threshold
				Yes	5	1.2	10	1	Permanent migration if place utility falls sufficiently to overcome barriers
		Yes	No	No	20	4.6	11	5	Dissatisfaction generated
				Yes	1	0.2			
			Yes	No	2	0.5	12	0	Dissatisfaction generated
				Yes	0	0.0		0	Temporary migration to replace income lost
							13		
	Yes	No	No	No	22	5.1	14	9	Raise stress threshold
				Yes	18	4.2			
			Yes	No	4	0.9	15	1	Raise stress threshold
				Yes	5	1.2		1	Dissatisfaction generated and increased likelihood of migration
							16		
		Yes	No	No	34	7.9	17	10	Dissatisfaction generated
				Yes	10	2.3			
			Yes	No	1	0.2	18	0	Dissatisfaction generated
				Yes	0	0.0	19	0	Temporary migration or dissatisfaction generated

Chocna

Ecologically place dependent	Ecologically place attached	Satisfied	Mobile	High mobility potential	Count	Table N %	Decision group No.	% of pop. in decision group	Response
No	No	No	No	No	29	5	1	5	Migration not affected by changes in ecosystem services
				Yes	26	0			
			Yes	No	6	0			
				Yes	11	0			
		Yes	No	No	46	0			
				Yes	2	0			
			Yes	No	10	0			
				Yes	2	0			
	Yes	No	No	No	41	10	2	10	Raise stress threshold
				Yes	27	0			
			Yes	No	9	0	3	0	Raise stress threshold
				Yes	10	0	4		Permanent migration if place utility falls sufficiently
		Yes	No	No	53	10	5	10	Dissatisfaction generated
				Yes	4	0			
			Yes	No	12	0	6	0	Dissatisfaction generated
				Yes	3	5	7	5	Dissatisfaction generated and increased likelihood of
Yes	No	No	No	No	8	5	8	5	Raise stress threshold
				Yes	8	0			
			Yes	No	2	0	9	0	Raise stress threshold
				Yes	5	0	10	0	Permanent migration if place utility falls sufficiently
		Yes	No	No	20	10	11	15	Dissatisfaction generated
				Yes	1	5			
			Yes	No	2	0	12	0	Dissatisfaction generated
				Yes	0	0	13	0	Temporary migration to replace income lost
	Yes	No	No	No	22	5	14	5	Raise stress threshold
				Yes	18	0			
			Yes	No	4	10	15	10	Raise stress threshold
				Yes	5	0	16	0	Dissatisfaction generated and increased likelihood of
		Yes	No	No	34	25	17	35	Dissatisfaction generated
				Yes	10	10			
			Yes	No	1	0	18	0	Dissatisfaction generated
				Yes	0	0	19	0	Temporary migration or dissatisfaction generated

Caruya

Ecologically place dependent	Ecologically place attached	Satisfied	Mobile	High mobility potential	Count	Table N %	Decision group No.	% of pop. in decision group	Response
No	No	No	No	No	29	0.0	1	6.3	Migration not affected by changes in ecosystem services
				Yes	26	0.0			
			Yes	No	6	0.0			
				Yes	11	0.0			
		Yes	No	No	46	6.3			
				Yes	2	0.0			
			Yes	No	10	0.0			
				Yes	2	0.0			
	Yes	No	No	No	41	12.5	2	12.5	Raise stress threshold
				Yes	27	0.0			
			Yes	No	9	0.0	3	0	Raise stress threshold
				Yes	10	0.0	4	0	Permanent migration if place utility falls sufficiently to overcome barriers
		Yes	No	No	53	12.5	5	12.5	Dissatisfaction generated
				Yes	4	0.0			
			Yes	No	12	12.5	6	12.5	Dissatisfaction generated
				Yes	3	6.3	7	6.3	Dissatisfaction generated and increased likelihood of
Yes	No	No	No	No	8	0.0	8	0	Raise stress threshold
				Yes	8	0.0			
			Yes	No	2	0.0	9	0	Raise stress threshold
				Yes	5	0.0	10	0	Permanent migration if place utility falls sufficiently
		Yes	No	No	20	0.0	11	0	Dissatisfaction generated
				Yes	1	0.0			
			Yes	No	2	0.0	12	0	Dissatisfaction generated
				Yes	0	0.0	13	0	Temporary migration to replace income lost
	Yes	No	No	No	22	18.8	14	31.3	Raise stress threshold
				Yes	18	12.5			
			Yes	No	4	6.3	15	6.3	Raise stress threshold
				Yes	5	6.3	16	6.3	Dissatisfaction generated and increased likelihood of
		Yes	No	No	34	6.3	17	6.3	Dissatisfaction generated
				Yes	10	0.0			
			Yes	No	1	0.0	18	0	Dissatisfaction generated
				Yes	0	0.0	19	0	Temporary migration or dissatisfaction generated

San Mateo

Ecologically place dependent	Ecologically place attached	Satisfied	Mobile	High mobility potential	Count	Table N %	Decision group No.	% of pop. in decision group	Response
No	No	No	No	No	29	8.8	1	44.5	Migration not affected by changes in ecosystem services
				Yes	26	9.3			
			Yes	No	6	2.6			
				Yes	11	3.5			
		Yes	No	No	46	15.9			
				Yes	2	0.4			
			Yes	No	10	3.5			
				Yes	2	0.4			
	Yes	No	No	No	41	11.5	2	18.5	Raise stress threshold
				Yes	27	7.0			
			Yes	No	9	3.1	3	3.1	Raise stress threshold
				Yes	10	2.6	4	2.6	Permanent migration if place utility falls sufficiently
		Yes	No	No	53	15.4	5	16.3	Dissatisfaction generated
				Yes	4	0.9			
			Yes	No	12	3.5	6	3.5	Dissatisfaction generated
				Yes	3	0.4	7	0.4	Dissatisfaction generated and increased likelihood of
Yes	No	No	No	No	8	0.9	8	0.9	Raise stress threshold
				Yes	8	0.0			
			Yes	No	2	0.4	9	0.4	Raise stress threshold
				Yes	5	0.9	10	0.9	Permanent migration if place utility falls sufficiently
		Yes	No	No	20	1.8	11	1.8	Dissatisfaction generated
				Yes	1	0.0			
			Yes	No	2	0.9	12	0.9	Dissatisfaction generated
				Yes	0	0.0	13	0.0	Temporary migration to replace income lost
	Yes	No	No	No	22	2.6	14	3.5	Raise stress threshold
				Yes	18	0.9			
			Yes	No	4	0.0	15	0.0	Raise stress threshold
				Yes	5	0.0	16	0.0	Dissatisfaction generated and increased likelihood of
		Yes	No	No	34	1.8	17	2.6	Dissatisfaction generated
				Yes	10	0.9		0.0	
			Yes	No	1	0.0	18	0.0	Dissatisfaction generated
				Yes	0	0.0	19	0.0	Temporary migration or dissatisfaction generated

Surco

Ecologically place dependent	Ecologically place attached	Satisfied	Mobile	High mobility potential	Count	Table N %	Decision group No.	% of pop. in decision group	Response
No	No	No	No	No	29	4.8	1	17.3	Migration not affected by changes in ecosystem services
				Yes	26	3.0			
			Yes	No	6	0.0			
				Yes	11	1.8			
		Yes	No	No	46	5.4			
				Yes	2	0.6			
			Yes	No	10	1.2			
				Yes	2	0.6			
	Yes	No	No	No	41	6.5	2	13.1	Raise stress threshold
				Yes	27	6.5			
			Yes	No	9	1.2	3	1.2	Raise stress threshold
				Yes	10	2.4	4	2.4	Permanent migration if place utility falls sufficiently
		Yes	No	No	53	8.3	5	9.5	Dissatisfaction generated
				Yes	4	1.2			
			Yes	No	12	1.2	6	1.2	Dissatisfaction generated
				Yes	3	0.0	7	0	Dissatisfaction generated and increased likelihood of migration
Yes	No	No	No	No	8	3.0	8	7.7	Raise stress threshold
				Yes	8	4.8			
			Yes	No	2	0.6	9	0.6	Raise stress threshold
				Yes	5	1.8	10	1.8	Permanent migration if place utility falls sufficiently to overcome barriers
		Yes	No	No	20	8.3	11	8.3	Dissatisfaction generated
				Yes	1	0.0			
			Yes	No	2	0.0	12	0	Dissatisfaction generated
				Yes	0	0.0	13	0	Temporary migration to replace income lost
	Yes	No	No	No	22	7.1	14	15.5	Raise stress threshold
				Yes	18	8.3			
			Yes	No	4	0.6	15	0.6	Raise stress threshold
				Yes	5	2.4	16	2.4	Dissatisfaction generated and increased likelihood of
		Yes	No	No	34	14.3	17	17.9	Dissatisfaction generated
				Yes	10	3.6			
			Yes	No	1	0.6	18	0.6	Dissatisfaction generated
				Yes	0	0.0	19	0	Temporary migration or dissatisfaction generated