REPORT

RAINFALL, FOOD SECURITY AND HUMAN MOBILITY
CASE STUDY: PERU

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Case study: Peru

Results from Huancayo Province, Junín Region

Authors: Raúl Ho and Andrea Milan

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Abbreviations and acronyms

AGRORURAL: *Peruvian Rural Agricultural Production Development Programme*
CAN: *Andean Community of Nations*
CEPAL: *Economic Commission for Latin America*
CEPES: *Peruvian Center for Social Studies*
CONAM: *Peruvian National Environmental Council*
CP: *Circulation patterns*
Dr.: *Doctor of philosophy (PhD)*
EACH-FOR: *Environmental Change and Forced Migration Scenarios Project*
Engr.: *Engineer*
ENSO: *El Niño Southern Oscillation*
GDP: *Gross Domestic Product*
IEP: *Institute for Peruvian Studies*
IGP: *Peruvian Geophysical Institute*
INEI: *Peruvian National Institute of Statistics and Informatics*
IOM: *International Organization for Migration*
IPCC: *Intergovernmental Panel on Climate Change*
ITDG: *Intermediate Technology Development Group*
M.Sc.: *Master of Science (degree)*
Masl: *Metres above sea level*
MIMDES: *Peruvian Ministry of Women and Vulnerable Populations*
MINAM: *Peruvian Ministry of Environment*
NGO: *Non-Governmental Organization*
NOAA: *National Oceanic and Atmospheric Administration*
PRA: *Participatory Research Approach*
SENAMHI: *Peruvian National Center for Meteorology and Hydrology*
SST: *Sea Surface Temperature*
UCAR: *University Corporation for Atmospheric Research*
UNDP: *United Nations Development Programme*
UNFCCC: *United Nations Framework Convention on Climate Change*
UNU-EHS: *United Nations University Institute for Environment and Human Security*
WFP: World Food Programme

Executive summary

This case study is part of the "Where the Rain Falls: Climate Change, Hunger and Human Mobility" ("Rainfalls") project, conducted by the United Nations University Institute for Environment and Human Security (UNU-EHS) and CARE International, and supported by AXA Group and the John D. and Catherine T. MacArthur Foundation. Within the framework of the project, the Peruvian case study was conducted in the central part of the Mantaro basin, which is located in the department of Junín. The research team sought the views of three communities in the Shullcas sub-basin and its surroundings in order to understand the impact on their livelihoods caused by climate change and rainfall variability, and the way in which rainfall variability and livelihood and food security influence their migration patterns.

Two types of livelihoods could be distinguished within the research area, one associated with households on lowland near the city of Huancayo, and the other with those in the highlands. The lower ecological floor is characterized by farmers with small land holdings. As a result of their proximity to the city of Huancayo, they heavily rely on daily mobility to the urban area and the main perceived climatic threats to their livelihood are drought and insufficient rain. Populations living in the higher ecological floor are often shepherds. Because of the more limited access to the city of Huancayo, they more often migrate for a few years or permanently to Lima or outside of Peru, rather than commute daily to Huancayo. The main climatic threat to their livelihood is frost.

The results of this study show that changes in precipitation patterns are making farming activities riskier, and thus not allowing farmers to plan their agricultural activities as they used to do a few decades ago. Rainfall variability and bad weather are recognized by the communities as a cause behind low incomes and farming productivity, which in turn push them to migrate, rather than as a direct cause affecting migration processes.

Daily mobility to the urban area already plays an important role for the communities under investigation, especially for households living in the lower and medium ecological floors. The growing population does not have access to new lands and reliance on daily mobility is likely to increase as access to the city of Huancayo becomes easier. However, if local environmental and climatic conditions allow, most people prefer to stay in their communities and complement work in the fields with casual work in the urban area by commuting on a daily basis.

Development and adaptation policies should take into account the changing mobility patterns of the area and priority should be given to the vulnerabilities of the population and access to health and education services. Capacity to adapt to the changing climate and precipitation patterns should be built among farmers in order to effectively manage climatic risks. In this context, the improvement of environmental governance for water, waste and food security, as well as more specific activities like promotion of organic agriculture can offer – especially through partnerships among local farmers – interesting opportunities for rural development.

Section 1: Introduction

Scenarios of the Intergovernmental Panel on Climate Change (IPCC) suggest that climate change is likely to be an increasingly important variable with respect to human migration and displacement. The issue has come to the renewed attention of researchers and policy-makers in recent years (Black, 2001; Renaud et al., 2007; Piguet, 2008; Laczko and Aghazarm, 2009; Warner, 2010; Afifi and Jäger, 2010; Foresight, 2011). While there are no reliable estimates on the number of people who will move as a result of climate change impacts, the rise in the scale of population movement, particularly within countries, will be substantial.

One of the lessons learned from the literature as well as the EACH-FOR project (the first large-scale empirical project on environmentally-induced migration)[1] was that more work was needed to isolate independent climatic and environmental variables, develop indicators, improve methods and find evidence to support policy around climate change, migration and displacement (Warner et al., 2009; Jäger et al., 2009; Afifi, 2011; Milan et al., 2011). The "Rainfalls" project focuses therefore on rainfall variability as an important step towards filling these policy relevant knowledge gaps.

The Rainfalls project has three objectives:

(1) To understand how rainfall variability, food and livelihood security, and migration interact today.
(2) To understand how these factors might interact in coming decades as the impacts of climate change begin to be felt more strongly.
(3) To work with communities to identify ways in which to manage rainfall variability, food and livelihood security and migration.

1 With 23 case studies on Europe and Russia, NIS and Central Asia, Asia, sub-Saharan Africa and Ghana, Middle East and Northern Africa, and Latin America.

Within the framework of the Rainfalls project, the eight case studies (Bangladesh, Ghana, Guatemala, India, Peru, Tanzania, Thailand and Viet Nam) focus on objective (1), improving understanding on how rainfall variability affects food and livelihood security, and how these factors interact today with household decisions on mobility/migration among groups of people particularly vulnerable to the impacts of climate change. Objective (2) will be pursued through an agent-based modelling exercise that is not part of this report, while objective (3) will be pursued in 2013 through community-based adaptation in four of the countries under investigation, including Peru.

In the case of Peru, the study was conducted in the Central Andes and it sought the views of some communities in the sub-basin of the Shullcas and Hullahoyo Rivers[2], tributaries of the Mantaro River. The area was selected in order to understand the impact of climate variability, especially of rain, on local livelihoods and the way in which rainfall variability, livelihood and food security influence their mobility or migration dynamics as an adaptive strategy in response to climate change.

1.1 Peru: Geography, climate and population

Peru is located in western and inter-tropical South America, facing the Pacific Ocean, between latitudes 0º 2' 00'' S and 18º 21' 34'' S, and longitudes 68º 39' 7'' W and 81º 20' 13'' W. It is bounded to the north by Ecuador and Colombia, to the east by Brazil, to the southeast by Bolivia, to the south by Chile and to the west by the Pacific Ocean. The country claims 200 nautical miles of the Pacific along its coast as part of its dominions, according to international law.

Its territory is crossed from south to north by the Andes range, a chain of high mountains that divides the country into three very distinct regions: the coast, with desert climate from sea level to an altitude of 800 metres above sea level (masl); the sierra, with peaks in excess of 6000 masl; and the Amazon jungle in the east. A fourth region is formed by the Andean high plateau (3800 masl) that drains into Lake Titicaca, the highest navigable lake in the world.

Thanks to the presence of this mountain range, the country presents almost the entire range of climates: 28 of the 34 climates in the world (CAN, 2008), from the Pacific coast desert to the humid Amazon jungle. Temperature and precipitation depend on the altitude, resulting in a mega-diversity of ecosystems, species and microclimates, for which Peru is recognized, including its people and cultures. All these factors make Peru a very interesting case to study with respect to climate change.

The major cities are mainly located in the coastal strip, which accounts for 54.6 per cent of the population, and it shows the best industrial and commercial development of the country. The coastal valleys are small oases formed by rivers that originate in the peaks of the mountain range and discharge into the Pacific Ocean. Their basins are relatively small but Peru's rivers, which cut through the coastal desert strip, allow deriving water to irrigate the deltas of the valleys, giving rise to a thriving commercial agriculture.

The sierra is formed by the Andes range. In general, the northern Andes are characterized by lower altitude and they are more humid. The central Andes, where the research area is located, are the highest and steepest. The southern Andes are wider than the northern and central Andes. The plateau of Collao, near Lake Titicaca, also known as high plateau (3,800 masl), is located in this sector. Lake Titicaca is famous for being the highest navigable lake in the world and home to the Aymara culture and the ancient ethnic group of the Uros. In the mountains there

2 Two communities, Acopalca and Chamisería, are in the Shullcas sub-basin. The other community, Paccha, is located in the Hullahoyo sub-basin which is at the border of the Shullcas sub-basin. Both sub basins are part of the Mantaro basin and they are originated in the Huaytapallana glacier.

are numerous inter-Andean valleys that allow, mainly under rain-fed agriculture, a variety of food crops typical of the Andean region such as native potato and other Andean tubers (maca, oca, olluco). The higher and colder areas are devoted to grazing livestock (cattle, sheep and South American cameloids).

The jungle, located to the east, is a vast plain covered by Amazon forests and diverse vegetation. It constitutes almost 60 per cent of the land surface of the country. Two different regions can be seen: highland and lowland rainforests. The highland forest, or yunga, is located across the eastern flank of the Andes. Its altitude varies between 800 and 3,500 masl. It ranges from the northern border area to the far south of the country. The topography of this area is varied and the areas penetrated by the Andes range include areas with steep slopes.

The lowland Amazon rain forest or tropical forest is located between 80 and 800 masl.

With a population of 28,220,764 inhabitants, Peru is the fifth most populous country in South America. Its population density is 22 inhabitants per km^2 and its annual population growth rate is 1.6 per cent. Of Peru's population, 54.6 per cent lives along the coast, 32.0 per cent in the sierra and 13.4 per cent in the jungle region (INEI, 2008). Urban dwellers constitute 76 per cent of Peru's total population, while 24 per cent of Peruvian people live in rural areas. However, the agricultural sector is still one of the main sources of employment in the country (Agencia Andina de Noticias, 2010) (see Figure 1).

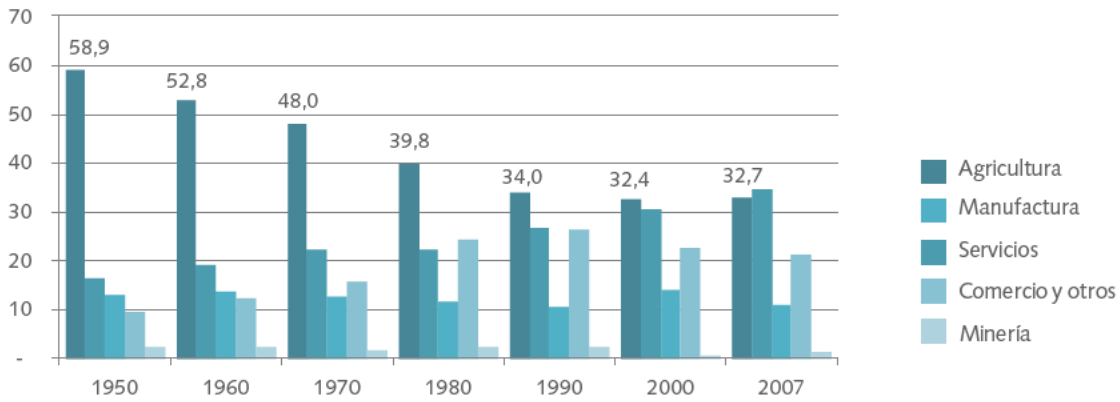

Figure 1: Peru: Economically active population by economic activity. Source: CEPES (2009).

Note: The five bars represent (from left to the right) agriculture, services, manufacturing, trade and others, mining.

Peru is a multi-ethnic nation formed over five centuries by the combination of different groups; a relative mestizo majority can be observed today. Indigenous people inhabited the Peruvian territory for several millennia before the Spanish conquest in the sixteenth century. At various stages in the history of Peru, its ethnic composition has changed, showing a steady decline in the Amerindian proportion as the result of multiple socio-economic and political factors, among which exclusion and racial discrimination are noteworthy. There are currently more than 5,600 indigenous communities, of which two-thirds are of Andean origin (Quechua and Aymara cultures), and the remaining third of Amazonian origin (distributed in 40 ethno-linguistic groups or indigenous peoples).

About a third of Peru's population depends directly on access to natural resources and on agriculture for its livelihood. In the past two decades, climate variability – manifested in the erratic occurrence of events like heavy rainfall, drought, frost, heatwaves and irregular variations in the duration of the cycles of rainfall, among others – is causing severe impacts on productivity in rural areas, as well as on the quality of natural resources, especially in the highlands of the sierra. Rural populations, mainly engaged in family farming in small plots, have faced increasing risks to their crops, and thus the deterioration of their income and food security. One of the main responses that rural populations use to manage climate uncertainty and production risks is migration to intermediate cities, and even temporary or permanent migration outside the country, when job opportunities in their places of origin are scarce. This study investigates these issues in greater depth.

1.2 Organization of the report

After this introductory section, Section 2 reviews the literature produced at the national level and that of the Junín region regarding climate and rainfall variability, its impacts on livelihoods and on human mobility patterns.

Section 3 gives a brief description of research objectives and the three methodologies used in collecting information: Participatory Research Approach (PRA) workshops, household surveys and interviews with local and national experts. This section also presents the limits of research in terms of the representativeness of the sample, difficulties encountered during field activities and information bias that could have occurred as a result of restrictions on the participation of key stakeholders.

Section 4 discusses the criteria followed in the selection of the research area and describes the area that was selected for this case study.

Sections 5, 6 and 7 present the results found with regard to variables of interest to the study: variability of rainfall, livelihood and food security and migration patterns, respectively.

Section 8 is an analysis of the relationship found between rainfall variability, food security and migration. The section also emphasizes the differences found between households of the valley floor near the city of Huancayo and those located in the higher elevations of the Puna ecological zone (above 3,800 masl). It also aims at understanding the circumstances under which households use migration as a risk management strategy in relation to increasing rainfall variability and food insecurity.

Sections 9 and 10 contain the conclusions on the changing patterns of rain in addition to some reflections for policymakers.

Section 2: Literature review

This section presents a short review of the literature on climate change and variability, livelihood and food security and migration.

2.1 Climate variability and climate change in Peru

2.1.1 Environmental issues

The environmental assessment of Peru (Grupo de Trabajo Multisectorial – Preparación del Ministerio del Ambiente, 2008), which was prepared when the Ministry of Environment was created, states:

"In Peru, the deterioration of the environment and natural resources is of concern due to high water pollution and deterioration of water basins, bad disposal of solid waste, disorderly cities with high air pollution and poor quality of life, loss of agricultural soil due to erosion, land salinization and fertility loss, the destruction of at least 10 million hectares of forests and illegal logging of precious woods, presence of 221 species of endangered wildlife, loss of native crops and their varieties, and air pollution.

The vicious circle of poverty, which exerts pressure on natural resources and the environment, has led to the current alarming deterioration processes of the environment and natural resources which also affect poor people in two ways: they reduce the natural resources which are essential for their productive activities (soil, water, forests, wildlife, fishing, etc.), and they have a strong impact on their health and social stability because of pollution and migration to cities and other regions like the Amazon." (Grupo de trabajo multisectorial, 2008: 7. Own translation)

The following problems characterize the respective geographic region:

- In the *desert coast*, the growing process of salinization and poor drainage of agricultural land (resulting from excessive irrigation), which affects approximately 40 per cent of its arable land (over a total of more than 1,000,000 hectares). In addition, less than 25 per cent of sewage is treated in Peru, while most of it is thrown untreated into the sea and rivers.
- In the *mountains*, soil erosion on steep lands and poor farming practices, combined with water contamination from mining activities. Ecosystems and agro-biodiversity of the area are increasingly at risk from increased mining activity, which grows without effective environmental control from the State and is consequently a source of growing socio-environmental conflict. Recently, the country has been discussing the urgent need for standards on ecological and economic zoning and land use planning in order to avoid further conflict.
- In the *Amazon forest*, illegal logging and the increasing presence of oil and gas extraction activities, which cause heavy damage to water resources, biodiversity and ancestral peoples, including protected natural areas. The rate of illegal logging (approximately 8,000,000 hectares of forest and deforested areas, which equals approximately 10 per cent of the country's forest cover) threatens the high mitigation potential of forests with regards to storing and absorbing CO_2 from the atmosphere.

- In the *highlands*, endorheic basin of Lake Titicaca, high contamination of its waters by processes of salinization and soil degradation, waste from mining activities and high population growth created large discharges of untreated wastewater into the lake itself.

- Peru also faces serious problems of *marine coastal pollution* (sewage from cities) and mangroves (north coast) as well as depredation of important marine species (anchovy) because of unsustainable rates of extraction.

2.1.2 Climate variability

At the Andean sub-region level, the Andean Community of Nations (CAN, 2008), in its study of the climate in its member countries, concludes that, since 1990, the temperature in the Andes has increased by 70 per cent more than the global average, that is 0.34 °C per decade, compared to the global average of 0.2 °C. In the same period, the number of extreme weather events has more than doubled in the region, showing a similar trend to that in other parts of the world. According to the same study, *"no province in the Andean countries has kept away from those problems, such as floods, droughts, frosts or landslides. The phenomenon of El Niño has caused major infrastructure damage and abruptly reduced the levels of agricultural production. Thus, between 2002 and 2006, almost six times as much agricultural land was affected than between 1987 and 1991." (ibid: 19, own translation)*

The hydroclimatic variability of Peru at the basin scale has recently been studied by Lavado et al. (2012). Peru has three main sources of drainage: the Pacific, Lake Titicaca and the Amazonas. Rainfall and runoff variability is very marked in the coastal basins following a seasonal and inter-annual pattern, in relation to extreme El Niño events in the Pacific Ocean. In contrast, rainfall and runoff are more regular in the Andes and Amazonas following an inter-annual pattern. Warm sea surface temperatures in the northern tropical Atlantic tend to produce drought in the southern Andes basins. Moreover, significant trends and ruptures are observed in the runoff of Amazonian basins where rainfall and runoff decrease, especially since the middle of the 1980s and during the low stage season. In order to understand climate change impacts on hydrology, the same authors analyse the hydrological response of two Peruvian Amazonas – Andes basins in relation to changes in precipitation and evapotranspiration rates inferred by the IPCC. Projections are available for the periods 2008–2040, 2041–2070 and 2071–2099. Annual discharge shows an increasing trend in the Requena basin (Ucayali River), Puerto Inca basin (Pachitea River), Tambo basin (Tambo River) and Mejorada basin (Mantaro River), while discharge shows a decreasing a trend in the Chazuta basin (Huallaga River), the Maldonadillo basin (Urubamba River) and the Pisac basin (Vilcanota River). Monthly discharge at Puerto Inca, Tambo and Mejorada basins shows increasing trends for all seasons. Discharge is estimated to decrease during autumn over the Requena basin and during spring over the Pisac basin; summer and autumn discharges are also estimated to decrease over both the Chazuta and Maldonadillo basins.

At the level of the great Amazon basin, a study published by the Royal Meteorological Society (Espinoza et al., 2009a) reported on rainfall variability. Based on data recorded during the period 1964–2003 at 756 meteorological stations in Bolivia, Peru, Ecuador, Colombia and Brazil, the report concludes that long-term variability and a decrease in rainfall since the 1980s is prevalent between the months of June to August and from September to November (early winter to late spring). The inter-annual variability occurs more specifically in the northeastern part of the Amazon basin and the southern tropical Andes. The study concludes by noting that the average rainfall in the basin decreased during the period 1975–2003 at an estimated annual rate of - 0.32 per cent, with this decrease being significant from 1982 onwards. The hydroclimatic variability of the Amazon basin has been further analysed through rainfall and discharge data from five Amazonian countries during the last 40 years (Espinoza et al., 2009a, 2009b). At the whole basin level, a diminution of annual rainfall of 9 per cent between 1975 and 2003 was documented (Espinoza et al., 2009a). Considering annual extremes, a low-stage diminution and strong high-stage values in the mainstream of the Amazon are particularly important since the beginning of the 1990s. They are associated with annual rainfall and discharge reductions in the southwestern sub-basins and with increasing rainfall and high-stage discharge in the north-west of the basin (Espinoza et al., 2009b; Ronchail et al., 2006). Rainfall and runoff diminutions are particularly evident in the Peruvian and Bolivian sub-basins (Espinoza et al., 2006; Lavado et al., 2012). Higher than normal tropical north Atlantic sea surface temperatures (SSTs) are related to rainfall runoff diminution over the Andean Amazon basins. In particular, the recent 2005 and 2010 extreme droughts in the Peruvian Amazon are related to warm SSTs (Condom et al., 2011). According to a sub-seasonal timescale, circulation patterns (CPs) over tropical South America are used to explain the hydrological variability (ibid). CPs are related to the progression towards the east of extra-tropical perturbations that modify the meridian winds east of the Andes and cause alternating convergence and divergence in the southwestern and northwestern Amazon.

2.1.3 Glacial melt

As reported by the IPCC Working Group 2, in the chapter on Latin America in the Fourth Assessment Report, glacial melt is a very important issue in Latin America. As a consequence of the temperature increase, the trend in glacier retreat already reported in the IPCC AR3 is accelerating and inter-tropical glaciers are very likely to disappear over the next decades, affecting water availability. Within Latin America, Peru is one of the most affected countries, especially because of its heavy reliance on the glaciers in the peaks of the Andes (Magrin et al., 2007: 584–585). Peru contains about 70 per cent of the world's tropical glaciers, which are distributed in 18 mountain ranges (Vuille et al., 2008), and their water reserves are used for agriculture, generation of energy, mining and human consumption (Leavell, 2008).

Glaciers play a strategic role in regulating the availability of water in rivers and lakes by melting slowly and allowing the river to maintain a base flow during the non-rainy period. Leavell (ibid) warns that the accelerated melting of glaciers in the Andes will affect water availability for the great demand centre that the Peruvian coast represents, where 55 per cent of the population resides:

"The concentration of Perú's population, industry and commercial agriculture along the narrow Pacific coastal plain poses sustainability issues for a future which promises warmer temperatures and limited glacial storage of water. Less meltwater contributions to the rivers will result in lower flow to the coast, and ultimately will impact irrigation, power generation and most importantly, drinking water supplies. … These glaciers are shrinking fast and many will likely disappear within 50 years." (ibid: 12)

As pointed out by Morales Arnao (2000), the retreat of glaciers in Peru has been accelerating for approximately three decades. For example, in an inventory performed in 1997 on 18 mountain ranges with glaciers, it was found that there was a 21.8 per cent reduction in the cumulative area of these peaks, compared to the base year of 1970. The Cordillera Blanca remains the most studied mountain range[3]. Recent studies show that, in the case of this mountain range, there was an advance of glaciers at the end of the twentieth century (Georges, 2004), which did not stop the marked decline throughout the last century. In fact, the analysis of satellite images shows that, in the late twentieth century, there were about 600 km² of glaciers in this range (ibid), which represents a significant loss compared to 643 km² in 1987 (Silverio and Jaquet, 2005).

3 *Cordillera* means mountain range. The Huaytapallana peak is part of the Cordillera Huaytapallana.

In the case of the Huaytapallana peak in the central Andes, the reduction affected 36.4 per cent of the area (Morales Arnao, 2000). These drastic reductions in freshwater reserves are endangering the country's overall development and the production of food on which a great part of the national population depends, and on which the rural population, which accounts for a quarter of the total population (INEI, 2008) is directly dependent. The process of deglaciation that the Huaytapallana snow peak (see picture on left-hand side) is experiencing is a general concern for all institutions of the Junín region since it will heavily affect water availability in Huancayo and the communities that are located in the lower part of the basin such as Paccha and Chamisería.

2.1.4 El Niño Southern Oscillation

The El Niño Southern Oscillation (ENSO) is a climatic event that is particular to the Pacific Ocean and occurs at irregular intervals of two to seven years (Salinger, 2005) (see Figure 2). It is characterized by variations in the surface temperature of the tropical eastern Pacific Ocean and the air surface pressure in the Western Pacific. The warming and cooling oceanic phases are known as El Niño and La Niña, respectively, and cause extreme weather conditions in many regions of the world. According to the IPCC (2007), this phenomenon is the leading cause of climatic variability in Latin America, where it has the greatest socio-economic impact, and Peru, in particular, is among those countries highly vulnerable to the impacts of climate variability. Since 1976, more El Niño episodes have been observed yet there is no clear-cut evidence linking these to climate change (Sperling et al., 2008).

Whilst the overall atmospheric interactions of El Niño are understood, specific impacts are difficult to recognize. El Niño events all have different temporal and spatial characteristics that also make them difficult to predict.

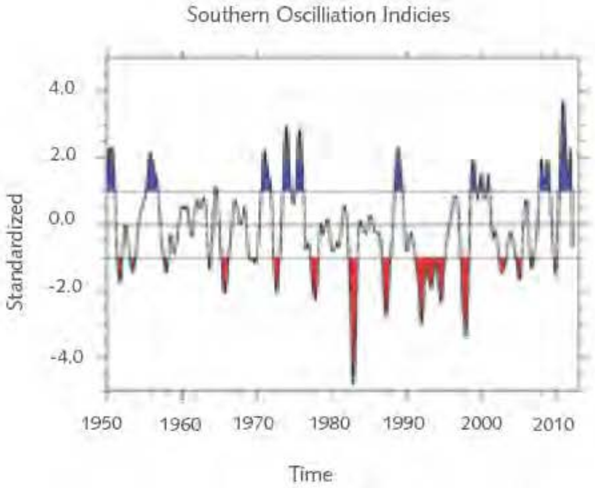

Figure 2: The Southern Oscillation Index, 1950–2010.
Source: UCAR (2011); data derived from Trenbeth (1984).
Note: El Niños are in red, las Niñas in blue. The Y axis refers to the standard deviation of the Southern Oscillation Indices.

The 1982–1983 El Niño led to economic and structural losses estimated at US$3.38 billion and the 1997–1998 events caused losses of US$3.5 billion; however, the 1982–1983 El Niño led to widespread drought in the high plateau while this was not the case in 1997–1998. At the community level, these large-scale events were well recognized as El Niño-related events while less severe events were not (Sperling et. al, 2008).

The high plateau is exposed to a great variety of factors related to climatic variability, including droughts, cold spells, floods, hail and unseasonal snowfall. While the climate is generally semi-arid, according to Garreaud and Aceituno (2001), El Niño intensifies the condition by suppressing the amount of moisture moving from the Amazon to the region. The opposite occurs during La Niña. ENSO may also influence the length of the seasons in the high plateau (Seimon, 2006). However, the influence of ENSO on the Peruvian Highlands seems to be considerably more complex and uncertain than in coastal regions in the north (Sperling et al., 2008).

Section 5.1 discusses rainfall patterns in the Mantaro basin and their relationship to the ENSO phenomenon.

2.2 Livelihood and climate variability

Peru ranks highly on the Human Development Index, with a score of 0.725 in 2011, which ranks it in eightieth place world-wide (UNDP, 2011). Peru is an emerging country, but in 2010, 31.3 per cent of its population was still below the poverty line (CEPAL, 2011), which suggests a high inequality index. In fact, according to CEPAL, the Gini coefficient for Peru was 45.8 in 2010 (ibid). For the same year, the World Bank estimated a Gini coefficient of 48.1 (World Bank, 2012a). Poverty, mostly in rural areas, is an important factor to consider when analysing the impacts of rainfall variability and other climatic events. People's ability to cope and adapt largely depends on their assets, social and natural capital, institutions and geographical position.

Every year, more young people are incorporated into the labour force but cannot find a job. Mining, electricity, construction and industry (the sectors with the highest growing rates and which explain the more than 5 per cent annual rate of national GDP growth in the last 10 years) only count for 14 per cent of the employed people in Peru, while agriculture still counts for 35.8 per cent (but with lower wages; on average less than 1,000 Nuevos Soles monthly, in contrast to mining or energy sectors). The other 50 per cent of the workers is employed in commerce and services (Gamero, 2006).

Chronic malnutrition is a serious issue in Peru. At the national level, 25 per cent of children under five suffer chronic malnutrition and, in the case of Junín, this figure exceeds 30 per cent

(WFP et al., 2007). In mountain areas the numbers are higher, which is consistent with the more extreme poverty that characterizes this region, compared to the coast or jungle:

"in rural areas in the mountains the incidence of extreme poverty is significantly higher than in other regions, 46.5% of households are extremely poor, while in the rural forest, 24.6% and in the rural coast, 14.4%. Therefore almost two-thirds of the poor in the rural highlands are homeless." (Trivelli et al., 2009: 82)

Populations in rural areas, especially in the mountains, are highly dependent on rainfall and climate, because food security is based on farming activities; 84.5 per cent of national agricultural properties are less than 9.9 hectares, according to the National Agricultural Census (INEI, 1994). Among these households, those who are subjected to subsistence and infra-subsistence conditions are the majority (more than two-thirds of them are small farms working on less than five hectares of land) and they supplement their income with non-farming activities. Agriculture barely allows them to produce enough to meet their own consumption needs.

According to a "Country Note on Climate Change Aspects in Agriculture for Peru" (World Bank, 2009), the following impacts related to climate change are expected to occur in Peru by 2050:

→ increase in summer average temperature by 1.3 °C, decrease in relative humidity by 6 per cent, increase in number of frost days in summer, and increase in sea temperature from 3 °C to 4 °C;

→ reduced rainfall in the northern, central and southern parts of the country by 10, 19 and 14 per cent, respectively;

→ increase in sea level, risk of flooding in low lying areas, erosion, saltwater intrusion and increased damage by rough seas;

→ increased frequency of ENSO.

According to the same source, in recent years (2003 to 2007), extreme temperatures and flooding have resulted in major human and economic losses in Peru, with losses for the period 1997–2006 of approximately 0.11 per cent of GDP. Five million people (18 per cent of the population) have been affected by extreme temperatures (three events) and 0.5 million (2 per cent of the population) by floods. The average annual cost of natural disasters over the period 2000–2004 was approximately US$ 325 million. The occurrence of disasters has shown an increasing trend over the years. Floods rose by over 60 per cent in the period 1970–1980 to 1990–2000, and landslides by almost 400 per cent for the same period.

The occurrence of the phenomena of deglaciation of the snow peaks, variability of rainfall and temperatures of the last decade, which are expressed in irregular occurrence of frost, drought, advance or delay of the onset of the rains, the shortening of the rainy season or increasing maximum temperatures, are causing great uncertainty in economic activities, mainly in the high Andean agricultural zone. The sharp drop in temperatures below 0 °C causes enormous damage to health and agricultural production[4]. For example, as indicated in the 2007 World Food Programme (WFP) and Peruvian Ministry for Women and Social Development (MIMDES)[5] report damage caused by low temperatures occurred in four departments of Peru:

"Frost, hail and snow affected the population of 13 departments of Peru between February and July 2007, particularly affecting the communities located on floors above the 3500–3800 masl. The drop in temperature caused an increase in incidence and mortality cases due to acute respiratory infections (ARI), especially in children of less than 5 years of age, in addition to having registered significant losses in major crops and livestock." (WFP and MIMDES, 2007: 3, own translation)

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4 According to the *Atlas de heladas del Perú* (2005), SENAMHI classifies frosts as low (between 0 and 3 °C), moderate (0 to -3 °C) and high (-3 to -6 °C).

5 Since the beginning of 2012, the ministry is now called the Ministry for Women and Vulnerable Populations.

Looking at the scenario of the sierra (mountains) area, Trivelli et al. (2009) point out that, according to the National Households Survey 2006, the poorest 20 per cent of the population in the rural mountains area obtains 50 per cent of its income through farming activities and the other 50 per cent through non-farming activities. For the richest 20 per cent of households, non-farming represents two-thirds of its income and only one-third comes from farming activities. This sheds light on the dependency of rural households in the mountains on agricultural activities and, especially in the case of rain-fed agriculture, of their dependence on rainfall and climate variability.

2.3 Migration trends in Peru

In the past few decades little has changed in Peru in terms of internal migration flows. Regions with high ingoing rates of migration are still predominantly on the coast, with some additional migration occurring towards the Amazon, while departments with higher rates of outgoing migration remain those in the southern sierra (Morales, 2007). This pattern is directly linked to the economic patterns within the country. Greater work opportunities and education are still concentrated on the coast (especially in Lima), as well as in smaller developed regions in the Amazon such as Ucayali and Madre de Dios.

According to the 2007 census, 4.5 per cent of the Peruvian population moved within their departments of residency between 2002 and 2007, whereas 6.2 per cent of the Peruvian population moved from one department to another. While high rates of internal migration from rural to urban areas have led to the extremely high level of urbanization in Peru, Cerrutti and Bertoncello (2003) argue that rural – urban migration flows have decreased and urban – urban migration is today the dominant form of spatial mobility.

Peruvian emigration started in the 1980s as the result of a severe economic and political crisis which manifested itself in armed conflict and hyper-inflation. Many young Peruvians, with very few work opportunities, migrated to other countries such as Chile, the United States, Spain, Italy, Germany and Argentina.

Today, over 10 per cent of Peruvians live abroad – close to 3 million people. In 2010, the net migration rate was -2.7 migrants/1,000 population. Research conducted by Peru's National Institute of Statistics and Informatics (INEI) and the International Organization for Migration (IOM) estimated that 2,038,107 Peruvians left the country between 1990 and 2009 and have not returned; of these, 50.4 per cent are women and 49.6 per cent are men. Their main destinations are Bolivia (19.7 per cent), Chile (19.4 per cent), the United States (18.4 per cent), Ecuador (14.6 per cent) and Spain (8.6 per cent). Moreover, 704,746 households have at least one former member living abroad (INEI, 2009; IOM, 2011).

International emigration has an increasing impact on Peruvian society and the economy. The country has seen a rapid increase in remittances received – from US$0.93 billion in 2001 to US$2.53 billion in 2010. The average of remittances sent is US$200.00 (IDB, 2006).

Altamirano (2012) indicates that the regional change in migration patterns in the Andean system and in the high jungle region is caused by the interaction of several factors, among them climate change. For example, populations move from dispersed to more concentrated settlements; these are not migrations in the strict sense, but human movements or mobility which operate within a more or less wide local context as the result of marriage, job opportunities or the search for more and better services for family welfare. This type of mobility generally has ecological costs because it involves a higher concentration of the population and the abandonment of fertile land to settle on small areas of lands. On the coast, it also has high costs because the population is located in the valleys and cities, of which some 80 per cent depend on water from glaciers in the Andes.

Section 3: Methodology

This case study report focuses on understanding under what circumstances households use migration as a risk management strategy in response to increasing rainfall variability and food insecurity today. It aims at understanding the differentiated impacts of rainfall variability in rural communities located on different ecological floors, whose livelihoods mainly depend on natural resources, agriculture and cattle herding, and the strategies or response mechanisms that they use to adapt or cope with the effects of climate change and rainfall variability in particular, with special attention paid to mobility and migration patterns.

A "base community" (Paccha) was selected in which the research team applied all of the PRAs techniques as described in the research protocol (Rademacher-Schulz et al., 2012) of the project with groups that are representative of the local rural society. In addition, the team conducted several PRA sessions in the two "satellite communities" (Acopalca and Chamisería) for support, so as to deepen understanding of the interactions between the variables under investigation, to triangulate the information collected from the base community and to check for common points and differences between villages. Complementing these workshops, 150 household surveys were applied, following random sampling methods, and 14 expert interviews were conducted at the national and local levels.

3.1 Methods

This sub-section introduces the three methods that were implemented for this case study: household surveys, PRAs workshops and interviews with local and national experts. The research methodologies were developed taking into account the lessons learned from the EACH-FOR project and the experience of CARE in participatory research, as well as from the literature in general (UNU-EHS, 2007; CARE, 2009; Stal et al., 2009; Piguet, 2010; Warner, 2011). An agent-based model will be developed through data collected during this case study; this is not part of this report (Smith et al., 2008). For more detailed information on the "Rainfalls" methodologies, please refer to the research protocol of the project (Rademacher-Schulz et al., 2012).

3.1.1 Household survey

The household survey was used to collect quantitative information from households about their economic activities, risks or threats to their livelihoods, variability of rainfall, food production, food consumption, adaptation strategies, migration patterns, local agents and institutions that support them, and assets available to the family.

The survey had an overall design that reflected the international scale of the "Rainfalls" project and therefore needed to be adapted to the local conditions. In Peru, the Spanish version of the survey used for the case study in Guatemala was reviewed to ascertain its fit with the local context through a pre-test of the survey in a community (Cochas Grande) that was not analysed during the main research phase. Once the surveys were corrected to make use of the local terms, the sample size was set for each community in line with the demographic information available. Table 1 shows the number of respondents by gender and community. There is an over-representation of women because of the limitations encountered during the fieldwork, as explained in Section 3.2.2.

Community	Number of households	Number of respondents		
		Total	Women	Men
Paccha	300	88	71	17
Acopalca	162	46	27	19
Chamisería	40	16	9	7
Total	502	150	107	43

Table 1: Number of respondents by gender and community. Source: Household survey.

3.1.2 Participatory Research Approaches sessions

Table 2 shows the PRA workshops conducted in each community: a total of 23 PRA sessions were held, 12 in the base community, Paccha; four in Acopalca; and seven in Chamisería. Only four PRA sessions were held in Acopalca because of difficulties in convening the sessions. A total of almost 150 people participated in the sessions, among them 25 men and approximately 125 women[6]. Section 4 refers to practical difficulties encountered in the field in relation to forming the groups for the workshops.

6 Please note that this is the sum of the number of participants in the single sessions, but the number of people who took part in the PRA sessions is lower than that because many people attended two sessions (few of them more than two) and were consequently counted twice. Information on the number of participants was not collected for three of the PRA sessions with women.

PRA	Session number		
	Paccha	Acopalca	Chamisería
Transect walk (only team and facilitator)	2	3	1
Historical events (women)	4		
Trend analysis (women)	5		
Seasonal calendar (women)	6		
Seasonal calendar (men)		23	20
Livelihood risk ranking (women)	7		
Livelihood risk ranking (mixed)	8		
Mobility map (women)	14		
Mobility map (men)	9		
Impact diagram (women)	10	21	
Adaptation strategies classification (women)	11	22	17
Food security Venn diagram (women)	12		16
Migration Venn diagram (women)	13		15
Focus group discussion on food security and migration (young women)			18
Focus group discussion on future strategies (young women)			19

Table 2: PRA sessions by community. Source: Household survey.

Greater emphasis was placed on: the seasonal calendar, given the diversity of agricultural and non-agricultural activities in the area resulting from the obvious urban – rural relationship established with the city of Huancayo; main risks and threats resulting from rainfall variability and its impacts on livelihoods and the strategies used to adapt to them; and the displacement or migration patterns (seasonal or temporary) that the participants practise.

3.1.3 Interviews with local and national experts

A third set of data came from local and national experts. Interviews revolved around three themes that are central to this investigation: variability of rainfall and climate change; impacts on the livelihood of vulnerable populations; and migration dynamics that occur as a result of the interaction of these factors.

During the field phase in Huancayo and subsequently in the city of Lima, it was possible to arrange interviews with local and national experts from various public and private institutions, as shown in Table 3:

Institution	Name	Title	Date
Ministry of Agriculture	Engr. Daniel Ruiz	Director, Directorate General for Agriculture	24/10/2011
Junín Regional Government	Engr. Ulises Panez Beraún	Regional Manager of Natural Resources and Environmental Management	24/10/2011
SENAMHI – Junín Regional Directorate	Dr. Adam Yanina Ramos	Executive Director	25/10/2011
National Water Authority (ANA) – Junín Region	Engr. Giovanni Vargas	Director, Local Water Authority – ALA Mantaro	25/10/2011
Universidad Continental de Huancayo	Engr. Jackeline Pérez Hilario,	Coordinator of the Environmental Engineering Program	25/10/2011
CARE – Huancayo	Engr. Bibiano Huamancayo	Departmental Coordinator CARE Peru, Huancayo and Huancavelica	26/10/2011
AGRORURAL	Engr. Jaime Torres	Coordinator of the pilot projects of AGRO RURAL in the PRAA framework	27/10/2011
Organic Maca and Agricultural Products Producers Association of Mt. Huaytapallana, Paccha	Mr Henry Wally	Association President	2/11/2011
Universidad Alas Peruanas de Huancayo	M.Sc. Luis F. Suárez Salas	Director of the Environmental Engineering Program	3/11/2011
Geophysical Institute of Peru – Huancayo	Engr. Jacinto Arroyo	Climate researcher	3/11/2011

Table 3a: List of interviews with experts in Huancayo. Source: Household survey.

Institution	Name	Title	Date
Universidad Nacional Agraria La Molina – Practical Solutions-ITDG	M.Sc. Juan Torres Guevara	Senior Lecturer Coordinator, Climate Variability and Change Program – PS-ITDG	8/11/2011
Pontificia Universidad Católica del Perú	Dr. Teófilo Altamirano	Senior Lecturer, Faculty of Social Sciences – Anthropology	8/11/2011
IOM – Lima	Dr. Víctor Torres	Head of Operations	10/11/2011
Ministry of Environment – MINAM	Engr. Claudia Figallo	Regional and National Adaptation Specialist	11/11/2011

Table 3b: List of interviews with experts in Lima. Source: Household survey.

3.2 Limitations

This section will discuss the major problems and limitations encountered during field research.

A general limitation of the study is that it was only conducted in the area of origin of migrants. This hinders understanding of the migratory process that maintains an interaction between factors related to the origin and destination areas. This is especially true in the case of past migration of people who have not returned.

In addition to this general point, limitations related to the site selection, household survey sampling and PRA sessions are discussed below.

3.2.1 Site selection

The original site selection proved problematic. Vilcacoto, which is in the lower part of the Shullcas sub-basin, was supposed to be the main village, but has been virtually surrounded by the urban sprawl of Huancayo. As a consequence, it did not meet the required rural condition. The team took the decision to replace it and selected the Paccha community as the base village.

Changing the base community at the last minute brought practical disadvantages in terms of access to the community. CARE was not working in Paccha so contacts had to be established very quickly.

Since most households buy food in the market, it would have been interesting to study the impact of trends in and variability of market prices for the main food items on food security. However, such analysis was not part of this project.

3.2.2 Household survey sampling

During field activities, difficulties were encountered in defining the sample size for each community, since no reliable demographic information was available, especially in the case of the village of Paccha. The search for data in the district municipality of El Tambo, where Paccha is located, was unsuccessful. The closest data were collected from the health centre and then readjusted as the team advanced through the visits to the seven neighbourhoods in Paccha.

An additional difficulty for the implementation of surveys in the three communities was the overlapping of fieldwork with the beginning of the sowing season. Most men were absent, either because they were sowing in the fields or doing other work, so mostly women were available for interviews. A more balanced gender representation would have been ideal but the beginning of the planting season created serious obstacles, despite the fact that researchers often followed respondents to their fields when conducting surveys (see Table 4).

Community	Households	No. of surveys conducted*
Acopalca	162	46
Chamisería	40	16
Paccha	300	88
Total	502	150

* Because of imprecise data available to the team in the first days of fieldwork, it was not possible to conduct in each community a percentage of surveys that corresponds exactly to the percentage of families with respect to the total.

Table 4: Number of households per community.
Source: Household survey.

Moreover, in the case of Paccha and Acopalca, many of the villagers who take part in the comunidad campesina (comuneros) live scattered in the highlands and only visit their villages periodically. For example, in Acopalca, comuneros who live grazing their herds of cattle go down to "town" every four months when community meetings are held to agree on the "faenas" (collective-type activities, such as the repair of roads, canals or the election of working committees). For those who are furthest away, it takes up to six hours to get to the village centre.

A higher participation of men would likely have enriched the results of the research in terms of finding more details on migration, perception of climatic events and agricultural production.

3.2.3 Participatory Research Approaches sessions

Many difficulties arose in the call to form groups for the PRA sessions. As mentioned above, given the timing of the research, sowing was a determining factor, causing most men to be away from home. Indeed, the team was able to have groups of men in just four sessions (including a mixed group), calling them in at night after their work in the fields was finished.

The research protocol (Rademacher-Schulz et al., 2012) recommended forming groups differentiated by age, sex, welfare or by type of livelihood or economic activity, according to the topic at hand. For example, when working on the chronology of historical events, a group of elders would be advised. In the case of classification of risks or threats to livelihoods, the protocol would recommend the formation of up to four distinct groups: farmers, non-farmers, most-vulnerable people and a group of women who undertake mixed activities.

This could only be done partially in this case study because of pragmatic constraints. The research team had to make the decision to work according to opportunity and availability of people at that particular moment. Most of the schedules for workshops were established two or three days in advance but they had to be adjusted according to circumstances.


TRABAJAR EN OTRAS COSAS
MIGRACIÓN
COMPRAR EN EL MERCADO

Section 4: Introduction to the case study area

4.1 General Information

The case study was conducted in the Shullcas river sub-basin (and its surroundings)[7], which is located in the central part of the Mantaro River basin (between latitudes 10° 34' 30'' S to 13° 35' 30'' S, and longitudes 73° 55' 00'' W to 76° 40' 30'' W) (see Figure 3). The basin is located in the region of Junín, in the central range of the Andes. The Shullcas sub-basin is located in Huancayo province, which is part of the Department of Junín. The Mantaro River is one of the most important rivers in the Peruvian Central Andes. Its flow depends on rainfall throughout the basin, the level of Lake Junín and the lagoons located at the foot of the snowcapped peaks of the western mountain range and of the Huaytapallana glacial peak. In the Peruvian Sierra, the Mantaro River basin has the best instruments for obtaining hydro-meteorological data, having hydro-meteorological equipment located throughout its length; it has one of the longest historical series of data in Peru (Huayao station since 1921). The Mantaro River basin is of great importance as the generator of about 35 per cent of the country's electric power. Agricultural production in the valley also provides food to Lima, and its population exceeds 700,000 inhabitants (CONAM, 2005a).

The Mantaro basin consists of 23 sub-basins distributed in the territories of the regions of Junín, Pasco, Huancavelica and Ayacucho. The sub-basin of the Shullcas River is where this study is focused, and it belongs to the province of Huancayo in the

7 As mentioned earlier, one community (Paccha) is located in the Hullahoyo sub-basin, which is on the border of the Shullcas sub-basins.

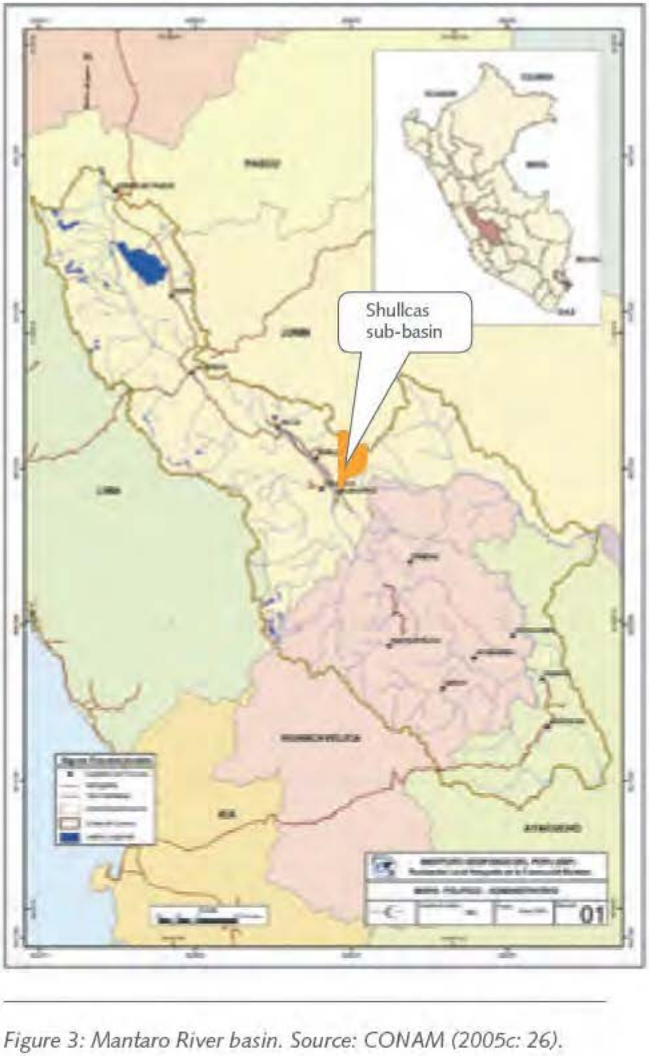

Figure 3: Mantaro River basin. Source: CONAM (2005c: 26).


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region (department) of Junín. The sub-basin is famous for the presence of the snowcapped Huaytapallana Mountain, whose highest peak reaches 5,557 masl, and it is the main source of water supply for the city of Huancayo (321,687 inhabitants).

The Population and Housing Census 2005 showed for the Department of Junín a population of 1,193,125 inhabitants. According to the Coordinated Local Development Plan of the Provincial Government of Huancayo (Municipalidad Provincial Huancayo, 2009), the population in the Huancayo province (according to the 2007 Census) was 466,346 inhabitants. The rate of inter-Census (1993–2007) population growth is 1.29 per cent. As for the urban and rural population, 78.4 per cent of the population of the province is concentrated in urban areas and 21.6 per cent in rural areas. As a province, Huancayo remains an area of emigration. The provincial net migration rate is - 3.1 per cent (INEI, 2009) (see Table 5):

4.2 Selected communities

The main criterion to select the research site, among others, was vulnerability of the rural population to variability of rainfall and bad weather, as is the case in the high Andean region. Moreover, incidence of poverty, existence of seasonal or permanent migrants, approval of local municipal authorities and the presence of CARE were all factors that were taken into account.

The department of Junín in the central Andes met the desired characteristics. It is a mountainous region, with snow peaks such as the Huaytapallana (5,557 masl) that are of interest to the study given the process of rapid deglaciation from which they are suffering. In particular, three communities belonging to the Shullcas sub-basin (and its surroundings, in the case of Paccha) were selected (see Figure 4).

District	Population (1993)	Population (2005)	Population (2007)	Inter-censal rate (1993–2007)	Density (Inhab/km^2)
Huancayo	100 116	104 117	112 054	0.81	472
El Tambo	112 284	143 28	146 847	1.94	1 996

Table 5: Demographic dynamics of two districts of interest to the study: Paccha belongs to El Tambo, Acopalca, and Chamisería to Huancayo. Source: Municipalidad Provincial de Huancayo (2007).

The Shullcas River is the main source of water for Huancayo, the capital of the Junín region and of the province of the same name. According to the 2006 – 2011 Urban Development Plan of the provincial government, Huancayo is a city of 321,687 inhabitants and it covers just over 4,000 hectares of urban land (Municipalidad Provincial de Huancayo, 2006).

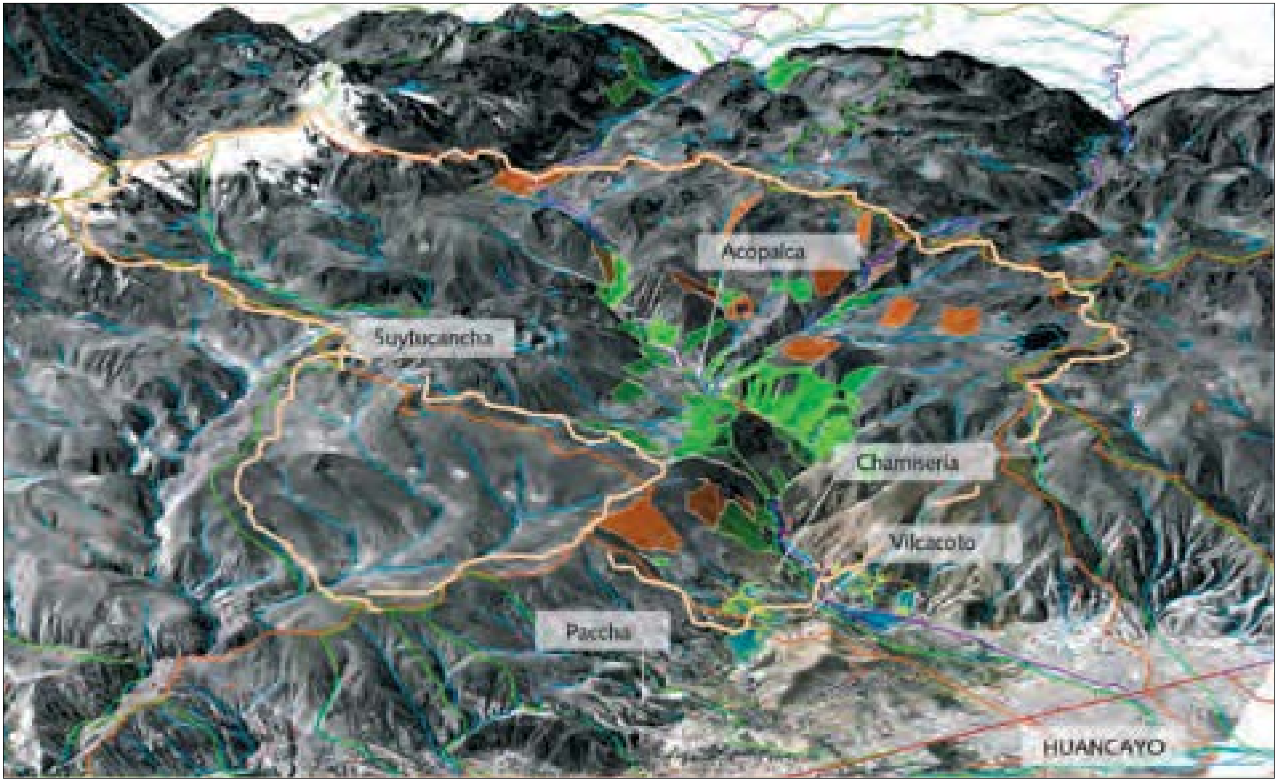


Figure 4: Shullcas sub-basin and the communities in the study. Source: Agrorural project. Note: Sub-basins are in sepia.

In the sub-basin of the Shullcas River, agricultural activities take place at between 3,200 and 4,800 masl, resulting in different ecological zones known as Quechua (2,500–3,500 masl), Suni (3,500–4,000 masl), Puna or Jalca (4,000–4,800 masl), and Cordillera or Janca (over 4,800 masl), as classified by Pulgar Vidal (1940). As one moves up in altitude, the weather becomes more severe, with frosts, hails, a marked rainy weather season (November to March) followed by the dry season, all of them with great variability that creates uncertainty and puts harvests at high risk. The multi-year average annual rainfall is 750 mm, with an average minimum temperature between 0.1 and 2 °C (CONAM, 2005a). With an approximate length of 35.9 km, the Shullcas River gives rise to a narrow valley that runs from the foothills of the Huaytapallana peak in the area of highest elevation, until the Mantaro River in the lowest area, on the east side of the city of Huancayo.

Within the area, the choice fell on the following rural communities:

Paccha

Paccha, located at 3,260 masl in the Hullahoyo sub-basin (which is on the border of the Shullcas sub-basin), was chosen as the base community. From an administrative point of view, Paccha is located in the district of El Tambo.

Paccha village consists of about 300 families. The rural community (comunidad campesina) itself is formed by 140 communal families, less than half of the population of the village, and many of them live scattered in the hills and highlands outside the village, where their grazing land is located. This land is mostly above 3,800 masl, and reaches an altitude of 4,400 masl in an area called Suytucancha.

Paccha has two distinct ecological zones. In the valley floor there is a variety of food crops such as potatoes, corn, oca, olluco, broad beans, peas and a range of vegetables. Most of the production is for self-consumption, and a smaller proportion is sold in the market of Huancayo. Residents in the village supplement their farm incomes with the craft activities of embroidery, weaving and the production of "engraved gourds"[8]. In the high ecological floor (Puna), the main activity is the breeding of sheep, cattle and some South American cameloids (llamas and alpacas) that leverage the extensive rangelands of communal lands (Suytucancha). Cattle ranches (estancias), grazing lands that are assigned temporarily by the rural community organization to its members in lots of 100 to 200 hectares, are located in this area.

Acopalca

Acopalca is in the Shullcas River sub-basin district of Huancayo, above 3,900 masl, near the foothills of the Huaytapallana snow peak and has 162 households. The entire production area of this community is on the Puna ecological floor, where advantage is taken of the presence of extensive natural pastures for livestock farming of sheep, cattle and cameloids. It is possible to grow, in very small plots in the warm folds of the land, some native tubers typical of the Andes, such as oca and mashua, and native potatoes used for family consumption.

Chamisería

Chamisería (legally part of the Acopalca community) is located in the middle ecological floor of the Shullcas River sub-basin, at 3,583 masl. It is inhabited by 40 households. Because of its location on the valley floor, it has a favourable climate for growing potatoes, corn, broad beans, peas and a diversity of vegetables in smallholdings of less than half a hectare, on a narrow river shore. People have lands on the slopes of the valley that allow them to keep small flocks of sheep (30 to 50). The relationship with the urban area, which is relatively close, allows its inhabitants to travel frequently to the city in search of odd jobs to help them supplement their incomes.

8 A kind of gourd, whose surface is worked with iconographic designs in low relief. The designs are a highly appreciated art form.

Section 5:
Rainfall variability

IGP and SENAMHI affirmed during expert interviews that rainfall patterns in the Mantaro basin are changing: in the last decade (2001–2010) there have been decreases in annual rainfall and changes in rainfall seasonality as the start of the rainy season has been delayed by one or two months. Analysis of rainfall data (CONAM, 2005c) confirms the decreasing trend in annual rainfall, as well as delayed and early rains.

This section analyses rainfall patterns in Junín and compares data and information gathered from expert interviews with the perceptions of communities.

5.1 Rainfall patterns in the Mantaro basin

A climate vulnerability study conducted in the Mantaro basin analysed the linear correlation coefficients between SST and precipitation data from 50 standard stations in the basin of the Mantaro River. SST indices were used by the National Oceanic and Atmospheric Administration (NOAA), which ranks the Pacific equatorial regions Niño 1+2, Niño 3.4 and Niño 3+4, as shown in Figure 5.

In the case of the Mantaro basin, the study found no relationship between rainfall in the rainy season from January to March and the warming of sea off the northern coast of Peru (region Niño 1 + 2). When the SST of the most remote regions of the Peruvian coast is taken into consideration, the correlation coefficient values increase. The relationships are stronger with the SST of the Niño 4 region. In this case, there is an inverse relationship, that is, a warming of the sea in the central equatorial Pacific inhibits rainfall from January to March in the Mantaro basin. The middle

Figure 5: Niño regions in the equatorial Pacific Ocean. Source: CONAM (2005c) and Lagos et al. (2005).

and southern Mantaro basin show the highest negative rates of correlation: between - 0.5 and - 0.8 in the case of the central part of the basin where the Shullcas sub-basin is located.

The same study concluded that the average rainfall for all existing stations in the basin shows a decreasing trend of about 3 per cent of current rainfall per 10 years (15 per cent in 50 years).

Silva et al. (2007) show that annual precipitation decreased at an average of - 5.6 mm/10 years in the time period 1922–2009, but two trends can be distinguished: from 1922 until 1976, annual precipitation actually increased by 4.5 mm per 10 years, while from 1977 until 2009 it decreased by - 54.3 mm per 10 years.

Figure 6 shows those years with a delayed or early rainy season[9] for the period 1965–2001. The 1980s were characterized by frequent delays and the first half of the 1990s by early rainy seasons, while rains in recent years, which were taken into account by CONAM, followed a more regular timing.

The diagnosis of current vulnerabilities in the Mantaro basin by CONAM concludes that the direct influence of inter-annual climate variability on crops is marginal, except where such variations are of great magnitude or duration, as happened during the drought of 1991–1992 (CONAM, 2005c).

During the interview, SENAMHI – Junín also indicated that recent years have been characterized by more irregularity, with heavier and more widely spaced rains than in the past. Moreover, it stated that when the planting season begins there are sporadic droughts that last up to seven days, whereas before they lasted for three days on average, and this causes damage to the newly planted crops. There is variability in the behaviour of the rain that hinders the planning of planting activities and creates uncertainty among farmers.

With respect to the future, changes in precipitation are not expected to be uniform in the whole Mantaro valley in the long-term (where the Shullcas sub-basin is located). In summer, slight increases are expected in the southern sector (5–10 per cent) from now to 2100. In autumn, a similar pattern is expected but in lower proportions. No relevant changes are expected in winter, while in spring an increase is expected throughout the valley (MINAM, 2010).

Finally, regarding the air temperature variability, the trends in maximum air temperature variability in °C/10 years are between 0.17 for the period between June and August and 0.26 for the period between September and April. The minimum air temperature, in the same periods, has a tendency to be between 0.16 and - 0.07 °C/10 years, respectively (see Figure 7).

Retrasos del inicio de la temporada de lluvias para los 100, 200, 300, 400, 500 y 600 mm. Los cuadros negros indician los años en que se dieron los retrasos.

Adelantos del inicio de la temporada de lluvias para los 100, 200, 300, 400, 500 y 600 mm. Los cuadros negros indician los años en que se dieron los adelantos.

Figure 6: Delays and advances in rainy seasons in the period 1965–2001 from Huayao meteorological station. Source: CONAM (2005c: 43).

9 "For this analysis, 6 objective measures are defined on the date of onset of rainy season ... the measures used are the dates on which the accumulated rainfall since the beginning of the rainy season reaches values of 100, 200, 300, 400, 500 and 600mm. Measurement begins on July 1 and it ends on June 30 the following year; the accumulation of precipitation from July 1 was obtained the day in which rainfall amounts reached 100, 200, 300, 400, 500 and 600 mm. In this way, 6 series of time points were generated which show for each year, the day in which the amounts of accumulated precipitation are reached. For each of these six series the date on which the precipitation is expected to reach each of the amounts mentioned was estimated. If each year the date is one standard deviation below the average, it is seen as a signal of anticipated rain season, and if it is one standard deviation above the average, the situation is considered of delay" (CONAM, 2005c: 41).

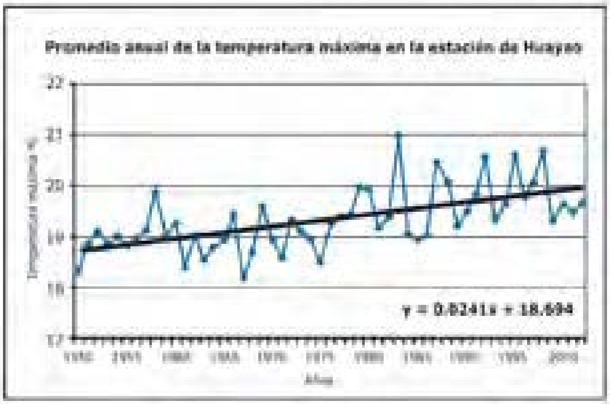
Tendencias en la temperatura máxima y mínima del aire en Huayao

TEMPERATURA MÁXIMA DEL AIRE

Junio-agosto		Octubre-diciembre		Enero-marzo		Setiembre-abril	
°C/10 años	°C/50 años	°C/10 años	°C/50 años	°C/10 años	°C/50 años	°C/10 años	°C/50 años
0.17	0.87	0.22	1.11	0.29	1.40	0.38	1.31

TEMPERATURA MÍNIMA DEL AIRE

Junio-agosto		Octubre-diciembre		Enero-marzo		Setiembre-abril	
°C/10 años	°C/50 años	°C/10 años	°C/50 años	°C/10 años	°C/50 años	°C/10 años	°C/50 años
0.24	0.79	-0.13	-0.67	-0.01	-0.03	-0.07	-0.25



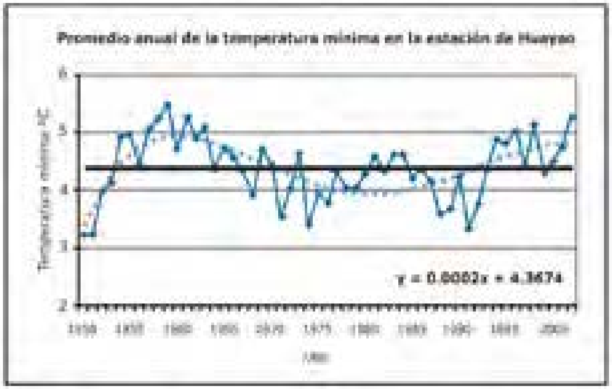


Figure 7: Temperature trends 1950–2002 from the Huayao meteorological station. Source: Adapted from CONAM (2005c).

5.2 Perception of precipitation change in the research area

The two most perceived changes in rainfall seasonality are more rains in unexpected moments and longer dry spells. More rains in unexpected moments, together with more dry spells in unexpected moments which were mentioned by 25 respondents, highlight the perception of unpredictability of changes in rainfall pattern.

In contrast with most PRA sessions, survey results show that more respondents perceive that the rainy season is longer, rather than shorter, with a ratio of 2:1 (see Table 6). Triangulation of data from PRA sessions and surveys with expert interviews shows that respondents in the communities do not have a clear and common view on rainfall seasonality.

Rainfall change	Yes
Longer rainy seasons	32
Shorter rainy seasons	15
More rain at unexpected moments	66
Longer dry spells	65
Shorter dry spells	4
More dry spells at unexpected moments	25
No response	0

Table 6: Perception of changes in rainfall seasonality from the household survey (in absolute numbers, out of 150 respondents) . Source: Household survey, Question 309.*

* The authors did not use percentages here since respondents were allowed to choose more than one answer.

Participants to the seasonal calendar PRA session emphasized that January and February are characterized by the threat of landslides. Frosts are typical of July and August, while hail characterizes the months of November and December. In terms of seasonality of drought, participants agreed that it usually happens between May and October.

Drought is the main concern of the respondents of Paccha, while in Acopalca and Chamisería drought concerns are relatively lower and flood concerns relatively higher (see Table 7).

Which natural events affected your household (at least once)?	Paccha %	Acopalca %	Chamisería %
(a) Drought	39	22	20
(b) Flood	28	27	30
(c) Storms	20	14	15
(d) Landslides (derrumbes)	1	5	5
(e) Mudflow (huayco)	2	17	20
(f) Other (frost, hail)	10	15	10

Table 7: Perceptions of rainfall-related events that most affected participants (percentage of answers for each event with respect to the total number of answers in each community). Source: Household survey, Question 225.*

* Please note that it was possible to give multiple answers. As a consequence, a total of 102 answers were given in Paccha, 78 in Acopalca and 20 in Chamisería (the total number of households interviewed was 88, 46 and 16, respectively).

Possible changes observed	More drought /dry spells?	More flood?	More heavy rain?	More extreme weather events?
Yes, a lot more	12	3	16	9
Yes, more	76	63	73	50
Same as before	19	19	14	37
No, less than before	3	13	5	2
Not existed at all before	1	11	2	1
Not applicable	0	1	2	2

Table 8: Perceptions of climatic changes (absolute number of answers out of 150 respondents). Source: Household survey, Questions 302–305.

Moreover, survey data show that the great majority of respondents identify new patterns in rainfall: more drought/dry spells and heavy rains, and somewhat increased floods (see Table 8).

All PRA participants perceived an increase in rainfall variability, which has one key consequence: farmers used to rely on their own climatic predictions to advance or postpone the planting but they cannot do so anymore because of the uncertainty of the rainfall. Moreover, PRA participants agreed on the decrease in the frequency of rainy days, which is associated with an increase in rain intensity. Frost and hail are perceived to be increasing; finally, Indian summers are perceived to be increasing in duration and/or more frequent at the beginning of the rainy season and during the first months after the crops are planted, causing losses or declines in crop yields.

Interestingly, PRA sessions showed that the perception of meteorological phenomena is different depending on whether households are located in the highlands (Puna, above 4,000 masl) or in the relatively lower and sheltered parts (Quechua, below 3,500 masl). Unfortunately, surveys could only partly capture this difference because people from Paccha are often depending both on the land at the lower altitude and on the pastures at the higher altitude (Suytucancha).

As shown in Table 9, there is a general perception that rainfall variability in its different expressions tends to increase. In the same vein, participants in PRA sessions reported that the average temperature has increased. On this point, IGP–Junín mentioned during the expert interview an increase of approximately 0.5 °C in the average maximum air temperature in the last decade (2001/2011) with respect to the longer-term average, which is in direct relation to the higher solar radiation.

Variable	Paccha village (below 3,400 masl)	Paccha (Suytu-cancha) (above 4,000 masl)	Chamisería (below 3,583 masl)	Acopalca (above 4,000 masl)
Rain variability	Increase	Increase	Increase	Increase
Annual rainfall (rainy season)	Decrease Great concern	Decrease	Decrease Great concern	Decrease
Rain intensity	Increase	–	Increase	Increase Great concern
Indian summer (sporadic drought)	Increase	–	Increase	Not serious
Frost	More frequent Increase	Increase Great concern	Increase	Increase Great concern
Hail	More frequent Increase	–	Increase	Increase
Snow	Decrease	–	–	Decrease
Solar radiation-temperature	Increase	Increase	–	–

Table 9: Perception of rain and weather.
Source: PRA sessions 5, 6, 7, 8, 10, 18, 20 and 21 (see Table 2).

In the case of the higher altitude communities – where the average minimum temperatures are between 0.1 and 2 °C – the most feared climatic risk is the occurrence of frost, whose severity and duration can generate high mortality in cattle and the unavailability of natural grasslands, as well as acute respiratory diseases in people, food security crises and economic losses from which farmers take years to recover. Because of the altitude, rainfall is greater than at the lower altitudes, and participants to PRA sessions dealing with issues related to rainfall do not feel that rain decrease is as grave as frost.

In the case of the communities located at lower altitudes, the greatest concerns are the decline in annual rainfall and the shortening of the rainy cycle, which affect crops and lower crop yields. In this area, farmers are involved in a variety of food crops and depend heavily on rain; moreover, rainfall is lower than at higher elevations, and sporadic droughts increase the uncertainty of agriculture. In both cases, the concern is the loss of assets (livestock, pasture or food crops) that can plunge them into transitory food insecurity or into poverty.

Section 6: Livelihood and food security

The first part of this section describes the sources of livelihood that were identified. Section 6.2 discusses food security in the research area, 6.3 focuses on the main poverty and land tenure issues and 6.4 highlights gender issues.

6.1 Sources of livelihood in the study area

The rural population on which this study is focused is clearly divided into two types of rural community. First, the high Andean communities of *Acopalca* and the upper part of *Paccha (called Suytucancha)*, whose main occupation is the farming of sheep, cattle and South American cameloids (llamas and alpacas), are located in the Puna ecological floor above 4,000 masl. The climate is cold, its average annual rainfall is about 800 mm (CONAM, 2005a) and frosts and hailstorms are frequent. *Comuneros* (members of the farmers' community) are organized into estancias or pasturage zones assigned individually by the communal authority for raising cattle. The communal authority keeps another part of the land under communal administration, depending on the extent of land available. Acopalca has approximately 24,000 hectares and Paccha (Suytucancha) 7,000 hectares of communal land[10].

Puna grasslands are low-yielding agricultural areas. On average, a typical family herd consists of 50–100 sheep, 6 cows and 10–20 llamas and alpacas, which require approximately 130–210 hectares of native pasture[11]. The population living in Puna sells meat, wool and some livestock in the cattle fairs of the neighbouring villages, usually from May or June when the animals are in peak condition. They complement their activities with work in Huancayo, and some (around 20 per cent of the men according to the seasonal calendar PRA session in Acopalca) get hired as shepherds for periods of three years in the US at least once in their lives.

Second, the rural communities of *Paccha and Chamisería*, which are located in the lower area, at altitudes of between 3,200 and 3,500 masl in the valley floor (Quechua ecological zone). These communities enjoy better access to the urban area of Huancayo. Households mostly perform family farming on small plots of land. The climate is warmer and allows the cultivation of food crops (potato, corn, broad beans, peas and a variety of vegetables). In these Quechua areas, plots of land have become, over time, smallholdings as the result of inheritance customs. Crafts such as embroidery and engraving gourds are on the rise, with the support of some government programmes that promote the formation of associations of craftsmen, and they allow for non-agricultural diversification. Family farmers tend to expect the creation of jobs locally with more government support so they will not have to migrate as often. People also complement their activities with occasional employment in the urban area of Huancayo and other cities (for example, Jauja and La Merced in the Junín district). Proximity and ease of access to urban areas and transport facilities enable people to combine their agricultural activities with employment outside of their farms (partaking in the coffee harvest season or in construction).

10 Author estimates based on local references and the National Chart (IGN).

11 Author estimates based on the interview with Nicolas Quilca, president of the community of Paccha, who mentioned that six hectares of natural grass are required to raise a cow, 8 for a llama, and 20 sheep are roughly equivalent to one head of cattle.

According to CONAM,

"variations in temperature, erratic rainfall, and extreme events such as drought and frost, increase pressure on agricultural resources and generate conflicts over their use. This situation is exacerbated by the fragmentation of agricultural land which is characteristic of the Mantaro basin, with small farms of less than 5 hectares, which together represent 85.7% of producers. Of the total land for agricultural production in the Mantaro basin, 29% is under irrigation and 71% is rain-fed, reflecting the high susceptibility to drought and extremely high (sporadic droughts) and low (frost) temperatures. The economically active population engaged in agricultural activities is 54.6% and it is susceptible to the climate variations that affect crops, and increase unemployment and rural–urban migration."
(2005c: 64, own translation)

Communities suffer from the impacts of rainfall variability in different ways, depending on their geographic location and degree of interaction with the city of Huancayo. In this sense, it could be argued that highland shepherds are more dependent on rainfall because they have lower non-farming diversification options and they are relatively far away from the opportunities offered by urban areas. Nevertheless, testimonies (open interviews) collected in the Puna area showed that highland inhabitants do not necessarily correspond to the poorest and most vulnerable families in the communities; on the contrary, some of them manage a sufficient number of cattle to maintain the educational needs of their children in the city of Huancayo.

Table 10 shows the greatest urban influence on Paccha as the main economic activity of the population is not agricultural (77 per cent). In Acopalca and Chamisería there is a balance between agricultural and non-agricultural activities, which confirms their more rural character and is in line with the general findings of Trivelli et al. (2009) for the Peruvian sierra. As mentioned earlier in this report, it was unfortunately not possible to distinguish between the livelihoods of those living at different altitudes in the survey since many households in Paccha depend on both their activities at low/medium altitudes, as well as those in Suytucancha.

Table 10 presents some results of the household survey regarding recent trends in the number of livestock owned and harvests. Triangulating this information with the results of the PRA sessions shows a clear perception of a decrease in the harvest (decreased or decreased a lot for over 80 per cent of respondents), while a minority of respondents mentioned a decrease in the number of livestock (between 30 and 50 per cent of respondents perceived this to be the case).

It is also noted that production for self-consumption is prevalent in all households, and is higher in Acopalca and Chamisería. A higher percentage of respondents in Paccha (19 per cent) are dedicated to cultivating for the market in contrast to Acopalca (2 per cent) and Chamisería (7 per cent). With respect to food security, there is a balance between survey respondents who declared not having suffered from food scarcity and those who declared to have been affected by it. In Paccha, the percentage of people affected by food scarcity is slightly lower, which is consistent with its higher interaction with the urban area.

Variable	Paccha %	Acopalca %	Chamisería %
In the last 5/10 years, your household's harvest			
(a) Decreased a lot	19	21	47
(b) Decreased	59	62	47
(c) Remained unchanged	9	9	6
(d) Increased	4	4	0
(e) Increased a lot	0	0	0
(f) Do not know/did not reply	9	4	0
In the last 5/10 years, the number of livestock in your household			
(a) Decreased a lot	8	13	13
(b) Decreased	23	43	20
(c) Remained unchanged	23	17	20
(d) Increased	16	10	13
(e) Increased a lot	0	0	0
(f) Do not know/did not reply	30	17	34
Does your household produce for consumption only?			
(a) Yes	72	94	87
(b) No	19	2	7
(c) Do not know/did not reply	9	4	6
Has your household faced food shortages in the last 5/10 years?			
(a) Yes	37	47	47
(b) No	47	51	53
(c) Do not know/did not reply	16	2	0
What is the main economic activity of your household?			
(a) Non-farming	77	50	53
(b) Farming and livestock	20	50	47
(c) Do not know/did not reply	3	0	0

Table 10: Survey results on livelihoods affected by rainfall variability. Source: Household survey, Questions 210, 216, 402, 502 and 802.

Finally, Tables 11 and 12 show a clearly decreasing trend with respect to the importance of agriculture as the first and second main economic activity for the households in the research area as a whole. Cattle herding is the most common main economic activity at present, in spite of a decrease in absolute numbers from 10 years ago. Embroidery/handicraft is the second most common main economic activity now, while agriculture was the second most common activity 10 years ago.

	Agriculture	Cattle herding	Embroidery/handicraft	Other	Total
Main economic activity (at present)	20	24	17	87	148
Main economic activity (10 years ago)	35	31	17	58	141

Table 11: Main economic activities at present and 10 years ago. Source: Household survey, Question 802.*

* The total number of respondents to the question was 148 (now) and 141 (10 years ago), as a result, about two-thirds of the answers are not counted here. Since the question on the main economic activity was open, only those respondents who clearly stated agriculture, cattle herding and embroidery and/or handicraft are counted here.

	Agriculture	Cattle herding	Embroidery/handicraft	Other	Total
Second main economic activity (at present)	29	20	31	44	124
Second main economic activity (10 years ago)	38	17	23	23	101

Table 12: Second main economic activities at present and 10 years ago. Source: Household survey, Question 803.

6.2 Food security in the study area

Food security is not a structural long-term problem in Paccha, Chamisería or Acopalca; instead, these communities are characterized by temporary periods of food insecurity.

Table 13 shows that the period between April and July is the best in terms of food security. Fewer than five respondents mentioned experiencing food insecurity during those months. In general terms, the agricultural cycle follows the rainy season: it starts in November and ends between March and April with the last harvests. On average, food obtained through the harvest lasts until July. Interestingly, the period between April and July is also when both men and women have the opportunity to migrate seasonally to the jungle to work on coffee plantations.

In the survey, respondents were also asked how much of the total food that their household consumes is purchased in the market. More than two-thirds of household respondents replied that they buy most of their food in the market and 80 per cent of respondents declared buying at least half of their food there. Thus, food security is clearly more dependent on access to food than on food production. Unfortunately, an in-depth analysis of the impact of trends and variability of market prices of the main food items that are bought in the market was not part of this case study.

With respect to food crop production, the results of trend analysis and livelihood risk ranking PRA sessions indicate that communities perceive a decrease with respect to the general production of the valley three decades ago. Participants believe the reason for this is the loss of soil fertility ("the earth is weary") as the result of uncontrolled use of agrochemicals. This is most noticeable in potato, corn, oca, olluco and broad bean crops and is compounded by the fact that it now rains less, which lowers the productivity of crops.

	Landless	Small farmer	Large farmer	Total
Jan	30	31	7	68
Feb	27	23	4	54
Mar	8	8	1	17
Apr	4	0	0	4
May	1	0	0	1
Jun	0	1	0	1
Jul	1	2	0	3
Aug	18	15	3	36
Sep	13	10	2	25
Oct	20	15	3	38
Nov	17	16	5	38
Dec	15	7	4	26

Table 13: Number of survey respondents mentioning the months of the year in which they regularly do not have enough food. Source: Household survey, Question 412.

With regard to livestock, cattle herders used to have more animals in the past. Women who participated to the impact diagram PRA exercise mentioned that pastures in the Puna do not grow as before because rainfall has diminished. However, a recent change is that today people have alpacas, which they did not previously have in the area.

The food crises in the research area have been caused by severe weather events (such as the frost in 2003 or the floods in 2007), and food insecurity experienced by people with low incomes has been mitigated by several social programmes provided by the regional and district governments.

During a PRA session (Venn Diagram) held in Paccha on institutions and actors that help in times of food insecurity, the most frequently mentioned were (in order of importance):

1. The medical post and the local Glass of Milk (vaso de leche) programme, which focuses on infants younger than seven years of age, nursing mothers and pregnant women.

2. The evangelical church "Roca Fuerte Internacional", which has been operating in Paccha for one year. Children between 0–9 years of age can have lunch there twice a week. In order to receive these benefits, mothers have to be part of the church.

3. The Soup Kitchen offers approximately 25 daily lunches in the community. Each lunch costs S/1.50. Participants do not need to be registered; anyone can go and get lunch. Funding is provided by the National Food Assistance Programme PRONAA.

4. The village shops that sell goods on credit with interest.

In contrast, PRA participants to the same exercise in Chamisería emphasized that family and close neighbours are the first people to whom they go when they need help. Only when these options are not available do people consider aid programmes and agencies. A key difference with Paccha is that the latter is an annex to the urban district municipality of El Tambo and, as such, can count on several state institutions.

6.3 Poverty and land tenure issues

In the case of the Junín region, poverty stood at 32.5 per cent and extreme poverty at 13.8 per cent in 2010 (INEI, 2011). However, there are districts where the population is predominantly rural and isolated, particularly at altitudes above 3500 masl, where extreme poverty is higher with respect to the regional average.

With respect to land tenure, an important issue is the process of fragmentation of land ownership in the case of the villages located in the lower ecological floor around Huancayo, resulting from inheritance practices as land is often divided when inherited by children from their parents. This process of shifting towards smallholdings shrinks assets and hinders asset accumulation for young households. Rural households aim to achieve the maximum productivity from family labour and, in that sense, it is more profitable for them to supplement their incomes with non-farming activities, as small farms are unable to fully absorb their labour. This situation increasingly boosts mobility to Huancayo and seasonal migration to intermediate cities in the central jungle, usually by the head of household. As this occurs, the family often remains in the village or town.

A different case occurs in the highland communities where cattle pasturages are not inheritable but revert to the community that holds the ownership of land; in this sense, they are protected from fragmentation. However, in recent decades, communal institutions and social cohesion for collective entrepreneurship are being weakened by the effects of an urban influence because a tension has arisen between collective initiatives and individual interests. The dissolution of community action brings disadvantages for the most vulnerable (elderly, single women and widows, or

the poorest in the community), who largely depend on solidarity and mutual support mechanisms.

Unlike farmers from the lower villages, cattle herders in the Puna often live alone in the pasturage, suffering inclement weather and lack of basic services. They usually leave their families in the nearest town, preferably in the city of Huancayo where the children can study and have a better standard of living. In this sense, the family migrates to the city but the head of the family remains in the pasturage.

When the pasturage and the cattle herd are relatively small, there are cases in which livestock care is left to the wife while the husband migrates for short periods or seasonally to undertake other trades (commerce, transportation, construction labour, etc.). This situation is common in families with babies or children below school age. When it is time for children to go to school, the opposite occurs, as described above[12].

6.4 Gender issues

The economic role of women in the Shullcas basin relates to resource management, income generation at home and responsibility for household chores. Women, who often do not have gas or electricity to cook with, have to look for wood to take home and they have to carry water for food preparation from remote areas. They are involved in various activities such as farming, producing cheese and butter, cloth embroidery, weaving sheep or llama wool, etc. Moreover, they often carry on the business of convenience stores – spaces that have become suppliers of staple foods for many families in the community. Through their daily movement to the city of Huancayo, women market their agricultural products, bringing products from the city for their own supply and/or selling in the community. Likewise, they are also in charge of strengthening the ties of kinship with the family that is in the city of Huancayo.

12 Information obtained not only through PRA sessions but also through informal discussions with the president of the community of Paccha and with a shepherd from Suytucancha.

Within the household, women mainly decide on the resources for family consumption, such as livestock, horticultural crops or income that they can generate by selling crafts. Culturally, gender inequality is still an issue and women are orientated towards the domestic sphere of the household. In contrast, men are engaged in work outside the house, relationships with other communities and work outside their communities. Generally, the decision on which crops or livestock are to be sold in the market is made by the head of household, which is usually a man.

Another gender-related issue is the scarce participation of women in decision-making in the community, in which they still do not have a defining role despite their knowledge and economic participation in the productive and domestic activities of their households. It is a tradition that men represent the household in the local assembly, with little representation of women. They should, however, be involved in the capacity-building processes for the benefit of the community (see Table 14).

Finally, access to education for many women in the area is not adequate. Many cases have been found where women have no schooling whatsoever, especially women who are over 50 years of age and live in the upper ecological floor areas.

	Paccha	Chamisería	Acopalca	Total
Households interviewed	88	16	46	150
Female-headed households	19	3	9	31
Female interviewees (counted)	71	9	27	107

Table 14: Female-headed households and number of women interviewed per community. Source: Household survey.

Section 7:
Migration and human mobility patterns

Depending on the study, Junín shows a negative migration rate of between - 3.6 per cent (Garcia Naranjo, 2007) and - 4.1 per cent (Yamada, 2010). The population of the research area perceives that out-migration has increased compared to 30 years ago. Local and national experts agree that there is evidence of rural–urban migration and it was very marked during the 1980s and 1990s: the urban area in Huancayo grew by approximately 50 per cent between then and now. Conflict also influenced migration dynamics, with people abandoning those areas, especially in the highlands, which were more heavily affected by it.

In the research area, young people are going in search of work to other provinces such as Satipo and Huánuco on the outer edge of the jungle, especially during the coffee harvests. In the case of the lower part of Paccha and in Chamisería, it is common for people to go, both occasionally and permanently, to work in Huancayo, where they commute daily in collective rural taxicabs (colectivos), which take no more than half an hour to get to the city and operate from 5 am to 8 pm. The lack of collective taxicabs after 8 pm is perceived by some as a hindrance to their job opportunities, since shops in Huancayo often close after 9 pm. In the city of Huancayo, many men work on construction sites as masons, while the youngest go to the capital city of Lima for two months during the school vacation period and return when classes start.

Overall, when scored and weighted[13], the three most important reasons determining migration decisions/moving to another place were (in descending order):

- better job opportunities in the city;
- not enough income in the community;
- unemployment in the community.

Among environmental factors, longer drought periods and increases in drought frequency were the most important reasons.

Table 15 shows some results obtained from the survey regarding migration patterns. It shows that temporal/permanent migration prevails over seasonal type in every community, but temporal migration remains more pronounced in Acopalca (17 per cent of seasonal migration versus 83 per cent of temporary migration). On the reasons for not migrating, a high percentage of respondents in all communities mentioned family and being satisfied with remaining on the site. Acopalca is the exception, showing a lower percentage of respondents who are happy with remaining on site (17 per cent versus 36 per cent or more expressed by respondents to the same question in other communities).

Roughly half of survey respondents (48.6 per cent) said that it is the migrant him or herself who takes the decision on whether to migrate or not. The decision is taken by the household head according to 22.4 per cent of respondents, while 15.9 per cent of the replies indicated a consensus of all household members (13 per cent of respondents did not know).

13 Survey respondents were asked whether each of a list of social, personal, conflict-related, economic, natural surroundings-related and food security-related factors was “very important”, “important” or “not important” with respect to the migration decision/moving to another place. The score for each of the factors was calculated by summing up the number of respondents mentioning the answer, multiplied by 2 for “very important”, 1 for “important” and 0 for “not important”.

	Paccha %	Acopalca %	Chamisería %
Type of migration*			
(a) Seasonal migration	37.5	17	35
(b) Temporal/permanent migration	62.5	83	65
Total	100	100	100
For which reasons did you stay?			
(a) No money	10	6	7
(b) No contacts	7.5	3	7
(c) Not separate from family	11.8	20	13
(d) Satisfaction (content)	36.5	17	40
(e) Take care of family	22.6	25	33
(f) Other	8.6	14	0
(g) Do not know	2	14	0
Total	100		

* The following definitions of migration were used: "[*Temporal*] migration can be defined as a move from the household of origin during at least six months per year to a place within the country or abroad with the purpose of working, studying or family reunification, over a distance that forces the concerned person to settle at the destination to spend the nights. … *Seasonal* migration can be defined as yearly recurring migration over periods less than six months a year" (de Haas, 2003: 414).

Table 15: Survey results on migration issues.
Source: Household survey, Questions 109 and 758.

In the last 5–10 years, if there have been times when you did not have enough food or money to buy food, did you…*	Paccha %	Acopalca %	Chamisería %	Total %
1. Modify food production to increase output?	11	8	8	9
2. Reduce household food consumption?	11	17	8	13
3. Diversify activities in order to increase alternative income?	33	23	16	27
4. Sell household assets?	4	6	20	7
5. See migration of household members?	4	21	8	10
6. Reduce expenditure?	20	13	24	18
7. Rely on external help?	14	9	16	13
8. Other options/does not know/ not applicable.	3	3	0	3
Total	100	100	100	100

* Multiple options are possible. Numbers are percentages with respect to the total number of answers per community. As a consequence, a total of 94 answers were given in Paccha, 64 in Acopalca and 25 in Chamisería (the total number of households interviewed was 88, 46 and 16, respectively).

Table 16: Coping strategies of households when food (or money to buy food) is not sufficient.
Source: Household survey, Question 601.

Looking at the general results of Table 16 (see last column), "diversify activities" (other than agriculture) is revealed as the first choice coping strategy in times of food insecurity. "Reduce household expenditure" is the second, "reduce household food consumption" and "rely on external help" are third, and "migration" is the least preferred option. When looking at the results by community, "migration of household members" is in second place in the case of Acopalca, where the climate is more adverse and families rely heavily on natural pastures for raising livestock. That is, at higher altitudes, in the presence of adverse weather that restricts the possibilities for diversification of productive activities, migration tends to be a more common adaptation strategy than in the case of the communities on lower floors, where there is easier access to the city and livelihoods are more diversified.

According to participants in all migration-related PRA sessions, migration is profitable as long as people migrate legally. Remittances sent by people abroad are intended for the education of their children, feeding the family, home improvements or repairs, and sometimes the expansion of family businesses – such as a small shop or buying a car for transportation. They are perceived to be a substantial contribution to those households who receive them.

The Venn diagram PRA session on migration in Paccha indicated that first, family and second, friends and neighbours are the most important sources of support in the migration decision and process. Family was mentioned as the source of the most important support for potential migrants, to which they turn most frequently. Friends and neighbours, like family, are easily accessible and can be trusted in situations of mobilization or migration. It was even mentioned that, in some cases, this group of people provide migrants with better support than the family; because there is no family relationship, there is less tension and conflict.

Money lenders were named as the third source of support. They are unable to provide a large amount of money (above 1,000 nuevos soles[14]) but they can lend money quickly, even within a day. However, PRA participants stated that lenders charge high interest rates (10 to 20 per cent), so they are only considered when money is required unexpectedly or in the case of emergencies. The last source to be mentioned was the bank, which, unlike the money lenders, is able to lend "large" sums of money, for example 4,000 to 5,000 nuevos soles[15]. However, access to such a loan is very complicated and cumbersome, as there are many requirements and, even when the loan is approved, the bank takes time to deliver. Therefore, it is highly unlikely that potential migrants will resort to the bank for loans.

The participant responses for Chamisería to the same Venn diagram show that they also receive credit from a non-governmental organization (NGO). More than half of the survey respondents (55.7 per cent) stated that migration costs are met by savings, while only 8.2 per cent replied that they are met by loans.

Two types of mobility or migration can be distinguished in the research area: one normally associated with people who live near the big city (Paccha village and Chamisería) on the floor of the valley; the second, with those who live in the highlands of the Puna (Acopalca and Paccha – Suytucancha communities). In both cases, it is usually the young and adult men (but not the elders) who migrate, leaving women behind to care for the home and farm.

The two sub-sections below describe the contrast between life patterns and activities that differentiate the two types of livelihood and migration patterns on both ecological floors. The distinction between the two types of livelihood could be used as a working hypothesis for future research to help better understand the migration patterns of the Central Andes in Peru.

14 Approximately US$370.
15 Approximately US$1500–1850.

7.1 Migration around Paccha and Chamisería (lower and medium altitude)

In Paccha and Chamisería, most people who work outside the village *commute daily* to the city of Huancayo, taking advantage of everyday transportation facilities, whether for study, in the case of the young, or for any type of job such as masonry or commercial activities, in the case of adults. Bus tickets to Huancayo are relatively cheap – a bus ticket from Chamisería to Huancayo costs 1 nuevo sol[16]. People also go to neighbouring areas, such as Quilca, Racracaya and Tiso (located on higher ecological floors), where they frequently share livestock pasturages, exchange corn for Andean tubers or participate in fairs and traditional celebrations in the villages.

Participants in migration-related PRA sessions also highlighted that a second type of mobility, which is typical of Chamiserìa and Paccha, is *seasonal migration* to intermediate cities in the central jungle region (La Merced, Satipo and San Martin de Pangoa) to work on the coffee harvest (between March and August), or on the pineapple and ginger harvests. Moreover, in the school vacation period (January to February), some young people go to Lima to work and return when classes begin.

A third type of mobility, *temporal/permanent migration*, typically occurs in relation to the capital city, Lima, where many young people go to seek new horizons. Some people who migrate to cities in the jungle for seasonal work end up staying permanently, as soon as they find the opportunity to undertake a business or agricultural activity.

Finally, there are frequent cases of *migration abroad.* Many families have a relative or acquaintance who has migrated abroad. The most common destinations are the United States, Chile, Argentina, Uruguay and Italy:

16 Approximately 0.35 US dollars.

- → *United States.* People migrate mainly to the states of California, Oregon and Colorado to work on livestock grazing. The standard time spent in those places is three years – after that, migrants either stay three more years or return. The cost of the one-way fare is, in many cases, paid for in advance by the party in charge of organizing the work contracts. In other cases, families sell their cattle, raising approximately 10,000 nuevos soles to pay for all the administrative processes at the embassy. In some cases, they obtain bank loans or raise the money from their family.

- → *Argentina.* Migrants go to work in commerce, establishing themselves in the labour market in Buenos Aires. Mainly young, single women migrate to Argentina to work as domestic servants and in garment factories.

- → *Italy.* Migration to Italy is not as common as migration to the United States and Argentina. It is mostly young women who migrate to Italy, to serve as caregivers for the elderly and children in addition to house cleaning.

7.2 Migration around Acopalca and Suytucancha (higher altitude)

In the mainly pastoral, higher altitude areas of Acopalca and Suytucancha (part of the Paccha village located 3800 masl), people more often migrate temporarily or permanently rather than go to Huancayo on a daily basis. Unlike the communities in the lowlands, villagers did not mention seasonal migration to intermediate cities in the central jungle. With respect to international migration, it was mentioned during several PRA sessions in Acopalca that 20 per cent of community members had apparently migrated at least once to the United States, where they were employed as shepherds under contracts that generally lasted for three years. Some have stayed, though they are few. In the higher altitude areas of the Shullcas sub-basin, flows of international emigration to other destinations (mostly Argentina) are significantly lower than those to the United States.

Women reported during migration-related PRA sessions that, when their husbands migrate, children are saddened, the man's contribution is missed and their home is less secure. Despite these problems, the economic contribution of the person working outside the community often ensures better living conditions for all members of the household. The living conditions in the pasturage are harsh because shepherds do not even get basic amenities (they live in very rustic homes with no special protection against the cold of the Puna, no potable water, electricity, sanitation, etc.) and live in very isolated conditions in remote sites. Therefore, the family generally resides in the nearest population centre or stays in Huancayo where their children study.

Section 8: Linking rainfall variability, food security and migration

This section pulls together the key facts/pieces of evidence from Sections 5 to 7 and analyses the findings on the interactions between rainfall variability, food security and migration. In particular, it aims at understanding under which circumstances households use migration as a risk management strategy in relation to increasing rainfall variability and food insecurity.

The populations of Paccha, Acopalca and Chamisería affirm that the variability of rainfall, together with frosts, sudden showers and heat waves, hinders planning of planting and agricultural production. However, the incidence of rainfall variability on food and livelihood security is receiving little attention because more households now depend on daily mobility to the urban area of Huancayo, where most people work in economic sectors that are not affected by rainfall. In the case of people living at higher altitudes, the relationship between rainfall variability and food security seems to be relatively more important, especially in the case of farmers and shepherds relying on rain-fed farming activities.

PRA participants from Paccha, Acopalca and Chamisería emphasized the direct relationship between rainfall variability and human mobility with regard to displacement caused by rainfall-related events, such as floods or landslides, or threat of landslides. They did not mention a direct relationship between rainfall variability and migration decisions. In most cases, they believe migration occurs as the result of better job opportunities in the city of Huancayo, low levels of household income and lack of job opportunities in the communities of origin. However, they recognized that rainfall variability has a relevant impact on farming productivity and it makes agriculture and cattle herding higher risk activities. It influences the migration decision, which is driven by several interconnected economic, social, political, demographic and environmental factors.

The relationship between food security and migration in the research area is not straightforward: populations are mostly affected by food insecurity for short periods. As a consequence, in hard times, it is much more common for local populations to rely on daily mobility to Huancayo rather than on longer distance migration. Participants in PRA sessions agreed that people who go to Huancayo are likely to find a job at the moment.

Local identity and culture have much to do with migration decisions. Rapid urbanization processes are eroding attachment to rural life and generational renewal of interest in agriculture, and it is important for future research to study how such factors may interact with the role played by rainfall variability and climate change in the processes of "deruralization".

Table 17 shows a key outcome of this study, which is that findings in the research area on rainfall variability, food and livelihood security and migration, and the connection between these variables, are different depending on the ecological floor.

Variable	Ecological floor: below 3,500 masl	Ecological floor: around 4,000 masl
Type of production	Diversified family farming and non-agricultural activity	Extensive cattle ranching and non-agricultural activity
Farm size	Smallholder	Pasturages 50 to 200 ha
Property of the pasturage and operating mode	Individual	Communal/individual
Main threat	Drought	Frost
Present condition	Urban (non-agricultural activities) predominate over the rural (agricultural activities)	Rural either predominates over the urban or is equivalent to it
Prevalent type of mobility	Everyday commuting to Huancayo, Seasonal migration	Temporal/permanent migration
Off-farm work	Frequent and seasonal	Multi-annual or annual contracts
Pattern of family organization	Family residence on the farm	Family residence off the farm
Views of the young about the future	Expectation of settling in the place of origin	Expectation of settling in the big city
Places of destination	Neighbouring villages, Huancayo and central jungle, US, Argentina (women)	Huancayo, Lima and US
Occupation of family labour on the farm	Partial; parents and children supplement income with non-agricultural activities	Pasturages 100 to 200 ha; full-time (only head of household)

Table 17: Livelihood characteristics and mobility patterns by altitude. Source: Authors.

Most of the results shown in Table 17 have already been discussed in previous sections. An additional result coming from a focus group discussion on future strategies with young women which was held in Chamisería is that, while young people from lower/medium altitudes expect to stay in their communities of origin, those from the higher altitudes expect to resettle in the big city. This result could be explained by the fact that the former can stay and easily travel to Huancayo daily, while the latter cannot. In spite of the current views of local youth, the urban area of Huancayo is growing fast (local experts estimated that there has been a 50 per cent increase in the urban area in the last 20–30 years) and means of communication are improving so that the gap in ease of access to the city is likely to narrow in coming years.

Temporary migration occurs both following a risk and economic diversification decision mostly driven by the pull factors of the city and/or as a result of unfavourable situations that push migrants out of their place of origin. The first case is common among households that have excess agricultural production and some savings, which allow them to seek better opportunities in the city. The second case mostly relates to households with income/proceeds around or below the subsistence level and which are pushed to migrate in search of job opportunities to supplement their low incomes in agriculture. Their low income often depends on scarcity of arable land and low farming productivity. Rainfall variability and bad weather are recognized by the communities as a cause of both low income and reduced farming productivity.

In the case of Acopalca, push factors are more pronounced and they play a key role in the increasing tendency to migrate[17]. As mentioned in Section 7, in Acopalca migration appears as the second choice among possible coping strategies in times of food and economic crises (see Table 16). Comparatively, this community (along with Suytucancha, belonging to Paccha but also situated on the higher ecological floor) shows a poorer socio-economic level than the other two communities on the lower floors, especially with respect to access to basic services.

A similar conclusion can be found in a study conducted by de la Cadena (1988), who studied migration patterns of people moving to Huancayo from two communities: one located on the valley floor and characterized by more diversified agriculture and economic growth (Pucsapampa), and the other on the higher ecological floor (Jarpa) and mostly based on cattle herding on native grasslands[18]. The study concluded that the economic situation of the peasant households in the community of origin influences migration patterns. On the one hand, rural households in Pucsapampa (lower ecological floor) managed to generate agricultural surpluses and to have certain levels of accumulation. They migrated to Huancayo looking for opportunities to invest their capital in urban-type activities and to generate higher returns. These migrants tended to integrate in urban areas in a relatively short time. On the other hand, the young peasants whose situation in the community of origin is poorer (mostly from Jarpa, on the higher ecological floor), were forced to migrate to urban areas driven by the need to get jobs that could supplement their farming income, which remained important for them, given the insecurity of urban employment. In this second case, support networks among relatives and friends were seen to be very important and a longer time was needed for migrants to integrate in the city.

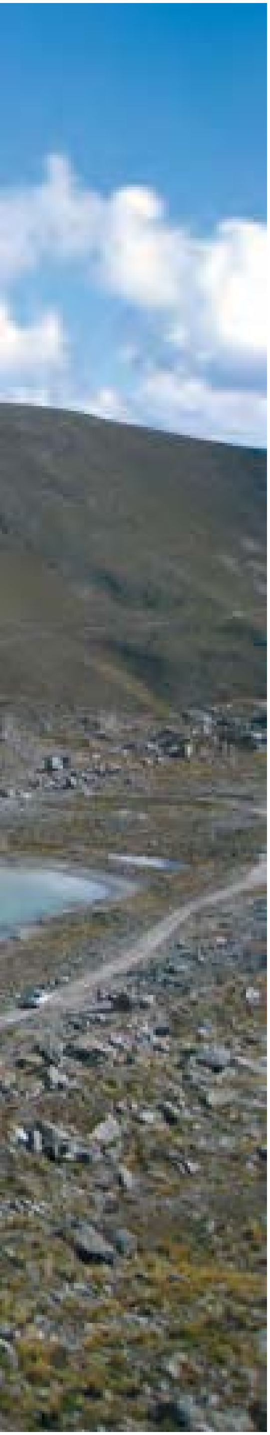
An increasing number of people in the research area combine rural and urban life. Those who settle in the city keep their agricultural plots and rely on kinship ties with members of their extended family to maintain work on them while they are away.

17 Only 17 per cent reported being satisfied with staying in the place of origin; see Table 15.

18 Jarpa and Pusacpampa, the two communities studied by de la Cadena, are located in the highlands near the towns of Chupaca and Concepcion, respectively. By bus, both communities are reachable within three hours of Huancayo.

In case the employment situation is bad in the city, they go back to the field, and vice versa.

The findings presented in Table 17 could be used as working hypotheses for future studies in the Peruvian highlands. It would be interesting to check whether distance from the city (which is reflected in easier/harder access to alternative work opportunities), altitude (which is reflected in different types of farming activity, as it is often more profitable to work on cattle herding than on agriculture above 4,000 metres) and rate of participation in the *comunidad campesina* (which, as mentioned above, has historically been the main source of support for the most vulnerable people in the Peruvian highlands) make a difference everywhere in the highlands or if there is a peculiarity in the research area of this project.



Section 9: Summary and conclusion

The results of this study indicate that households increasingly rely on non-agricultural activities associated with urban areas; however, the portion of income coming from agricultural activities in the rural areas is still important. Income from farming is complemented, not substituted, by income obtained through work in urban areas. As a consequence, farming activities are still important and there are always family members who are willing to replace those who migrate to the urban areas in undertaking the farming work.

In other words, migration is a process that involves the entire household, not only the individual who migrates. The member(s) that migrate to the city maintain a strong link with relatives who stay in the rural community, with a constant exchange of goods and services, at least for the time required for the migrant to settle and integrate into the receiving area. It should be noted that casual work in the cities is precarious and generates low pay, which strengthens the need for complementarity between urban and rural activities, given that working in the city alone would not provide sufficient income and/or would be too risky to cover the basic needs of the household. This tendency is also mentioned in a report by INEI (2009) on internal migration in Peru.

Several structural social, economic and environmental factors drive migration patterns in the Peruvian highlands. In this respect, household responses to crises in income generation or food production are different depending on the two ecological floors and on the socio-economic situation of the household in the area of origin.

When looking at the push factors from areas of origin, a key driver is the growing population combined with the stagnant agricultural frontier. As a result of its geographic location, the increasing population in the Andes does not have access to new land. Higher rainfall variability is making farming an increasingly risky activity and exacerbating the problems of farmers, especially in the case of rain-fed agriculture. As a consequence of these and other push factors, which often make living conditions in the highlands unfavourable, as well as the better work opportunities in the cities, people tend to move to urban areas.

In this context, and considering the results of this case study, rainfall and climate variability exacerbate livelihood and food security problems and, as a result, play an indirect though relevant role, as an accelerator, in migration decisions. Since migration is always caused by multiple interrelated causes, it is hard to identify migrants who moved in response to climate/environmental factors only.

The results of this case study show that migration is a very common practice among high Andean communities that are perceiving climate change as an increasing threat and it is valued as an important diversification strategy for livelihood, income generation and risk management. As a consequence, it is important to deepen the understanding of migration drivers and patterns in the Andes in order to prevent forced migration and make migration work for adaptation, in particular by designing policies that allow migrants to integrate successfully in the destination areas.

An interesting issue that is outside the scope of this project but should be studied in-depth, is the impact of the crisis of the traditional farming institution, the *comunidad campesina*, on migration patterns (see, for example, Diez, 1999). The most vulnerable people used to rely on these institutions during difficult times but these institutions are no longer able to effectively support them. The Peruvian economy has been growing fast in recent years so the main risk management strategy for people from Acopalca, Paccha and Chamisería has been to go to Huancayo to look for employment. It is hard to say if and how migration patterns would change should the job supply in Huancayo decrease – which is likely to happen if the Peruvian economy slows down (apart from 2009 when it only grew by 0.8 per cent, Peruvian GDP has been constantly growing at a rate of between 5 and 10 per cent in the last few years) (World Bank, 2012b).

There are very few studies on the interaction between climate and environmental change and mobility patterns in mountain areas (Kollmair and Banarjee, 2011). This case study report focuses on how one specific climatic factor, rainfall variability, affects food and livelihood security in the research area, and how these factors interact with household decisions about mobility/migration. However, it can provide useful insights for researchers who may want to explore in general the relationship between climate change and migration in mountain areas.

Physical and economic marginality, different levels of access to centres of economic wealth and political power, land steepness, land fragmentation, glacial melting, high exposure to low temperatures and frosts are all factors that proved to be very important in explaining food and livelihood security and mobility patterns in the research area. As these factors often characterize mountain areas in general, their interaction with mobility patterns should be investigated in other mountain areas of the world as well.

Section 10:
Reflections for policymakers

In defining strategies for adapting to climate change related to food security at both the national and local level, one must first understand the social and political processes that influence the vulnerability of the population. In this context, environmental governance is particularly complex, especially in a scenario whereby:

- "democracy" is widespread in the country but vulnerable to economic shocks;
- the role of integrated policy in shaping food security sometimes loses priority in the face of the urgency of political and macroeconomic matters, and in many spaces where political decisions are taken. An idea exists that environmental policies restrict economic and social development;
- family farming that prevails in Peru, and in the high Andes mountains in particular, needs to be more cohesively socially organized so that it can play a proactive role in dialogue with local development institutions.

The results of this case study allow for some reflections on policies that could be implemented at the *local level*, such as:

(1) Improve environmental governance for food security. Peru has designed the National Food Security Strategy for 2004–2015 to consider approaches to human rights, social management of risks, the prevention of malnutrition and land management processes. In most cases, food security programmes in Peru and other countries in the region have been focused on reducing child malnutrition. What is more, they have not been coordinated with development planning at the different levels of government. The national food security strategy also identifies lack of access to water and land as well as inequitable distribution of income for the most vulnerable in the population as structural problems. According to this strategy, food security policies need to be made sustainable, prioritizing participation of the institutions that promote land tenure and economic dynamism of domestic markets and production.

(2) Improve environmental governance with respect to water and waste. This is in direct relation to the ecological and economic zonification of local territories, and the promotion of sustainable relationships between mining companies and local communities because the mining industry is perceived to be polluting water and causing social unrest in such communities.

(3) Support organic agriculture. The increasing world demand for organic food can offer great opportunities. Global organic food and drink sales have increased more than three-fold in nine years (from US$18 billion in 2000 to US$54.9 billion in 2009), and double-digit growth rates were observed each year, with the exception of 2009 (because of the financial crisis). In the United States, main destination for Peruvian exports (US Department of State, 2012) sales of organic food and beverages in 2010 totaled US$26.7 billion (Research Institute of Organic Agriculture, 2011).

The Organic Maca and Agricultural Products of the Huaytapallana Glacier Association – which aims to provide products for the international organic food market – was created in 2009. Nevertheless, these producers are still at a very early stage of business and they are facing challenges related to their price competitiveness and productivity. As of autumn 2011, they were still a long way from getting organic certification and selling their products in the organic food market. The association needs support from local agricultural and development-focused governmental agencies.

(4) Encourage partnerships among small producers to overcome the limitations of small-scale farms.

(5) Coordinate promotion of the Shullcas sub-basin as a tourist area. Policymakers in the area are already trying to promote the area of Huancayo and the Huaytapallana glacier as a tourist destination. However, until now, this has not been done in a coordinated fashion. A structure exists for hosting tourists in Acopalca, which is not being used and currently cannot deliver the expected benefits because the area lacks a broader touristic infrastructure. The president of the community of Paccha is working with a local NGO to create a tourist park in the higher altitude areas, in the Bosque Dorado (Golden Forest) area. Again, the park should be part of a broader project so that it can be successful and bring tourists and new employment opportunities to the surrounding communities.

(6) Better coordinate governmental agencies dealing with agricultural production. There are several governmental agencies dealing with water and agricultural issues whose mandates often overlap. Better coordination among them would allow for better agricultural planning.

(7) Prioritize population vulnerabilities. Deglaciation of the Huaytapallana is attracting increasing attention. Unfortunately, measuring the glacial retreat is complicated; it is also very costly to intervene and preserve it. Considering the limited budget available to the local governmental agencies, priority should be given to the protection of the most vulnerable communities and households within communities, especially since the farming communities who used to provide support to the most vulnerable within each community are now in crisis. The work of CARE – Huancayo in Chamisería on Viviendas Saludables (healthy housing) is a good example of how relatively low-cost projects can improve life in local communities.

(8) Building capacity among farmers to increase agricultural productivity and reduce crop risk through crop scheduling and improvement of seed quality. SENAMHI – Huancayo provides support and promotes crop scheduling in particular, but the vast majority of farmers do not appear to take advantage of this opportunity.

(9) Commit to promote cohesion between comuneros and non-comuneros. Because not everybody in Paccha and Acopalca is part of the *comunidad campesina* (farmers' community), the division between members and non-members often leads to tension. A higher degree of cohesion is likely to be beneficial to the social and economic situation of these communities.

(10) Foster education programmes through which students can develop skills that they can use in their communities of origin, such as university degrees in forestry and agriculture. Several elder PRA participants mentioned that their sons and daughters who had received university degrees in Huancayo could not return to their communities of origin because they could not use their qualifications in them.

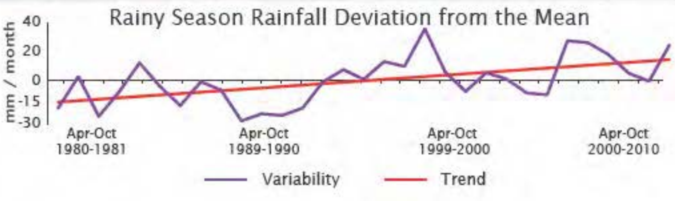
(11) Promote policies to support those who have migrated.
Local governments in the destination areas could identify migrants and support them in their urban integration.

(12) Promote better access to health services and education.
Rural communities should aim at narrowing the gap between their access to social services and that of people living in urban areas.

Annex I:
National research team composition

Gómez de la Torre, Juan
Morales, José
Ocaña, Roxana
Ortiz, Ingrid
Palma, Helen


Avg Precipitation (mm)
0-250
251-500
501-750
751-1000
1001-1250
1251-1500
1501-1750
>1750
Agricultural Land (%)
Irrigated (%)
>50
Rainfed (%)
1-4
5-15
16-37
Rainfall Variability/
Drought Frequency
very high
high
medium high
medium
low
very low
TO THE USA
PASCO
TO ARG
La Merced
Satipo
San
de
Acopalca
Chamiseria
Paccha
HUANCAYO
Lima
Where the Rain Falls Project
PERU
http://wheretherainfalls.org
Poverty
very low
low
medium
high
very high
Study Sites
Migration Paths (Generalized)
Migration Periods
Daily Commuting
Seasonal
Mixed
Permanent
Major Roads
Urban Areas
Activity
Coffee Harvest
Employment



Annex II

These maps were created by the Center for International Earth Science Information Network (CIESIN) at the Earth Institute of Columbia University. The main map showing the principal destinations and occupations of migrants from the research area is based on fieldwork, particularly focus group discussions and the household survey. In most cases, only one or more household member migrates while the rest of the household stays in the community and it diversifies its sources of livelihood there. The most common mobility pattern in the area (particularly for the lower altitude communities of the Shullcas sub-basin) is daily commuting to Huancayo, where people work in non-agricultural activities. International migration is mostly to the United States of America where people work both in agriculture and other economic sectors. Another significant international migration flow is to Argentina where men work in commerce and women as domestic servants and in garment factories. Moreover, young people migrate seasonally to Satipo, San Martin de Pangoa and La Merced to work on the coffee harvests (or on the pineapple and ginger harvests) and students go to the capital city of Lima for two months during the school vacation period and return when classes start.

Note: The maps (and associated rainfall variability graphs) produced for each case study report were developed using data sets from multiple sources. Each map provides the location of each research site along with contextual data on rainfall amounts and variability, poverty and agriculture. For a full list of sources please see chapter 9.2 of the Where the Rain Falls Global Policy Report (Warner et al., 2012.).

Source: CIESIN (2012).

References

Afifi, T., and J. Jäger, eds. (2010). *Environment, Forced Migration and Social Vulnerability.* Dordrecht, London, New York: Springer, Heidelberg, pp. 197–209.

Afifi, T. (2011). Economic or environmental migration? The Push Factors in Niger. *International Migration Journa*l, International Organization for Migration, Special Issue, Blackwell.

Agencia Andina de Noticias (2010). *Sector Agropecuario ocupa al 32.5% de la Población Económicamente Activa en Perú.* 26 October. Available from http://www.andina.com.pe/Espanol/Noticia.aspx?id=E+YbfqS6v0c.

Altamirano, T. in press. *Refugiados Ambientales: Cambio climático y Desplazamiento Humano*. Lima: Fondo Editorial de La Pontificia Universidad Católica del Perú.

Black, R. (2001). Environmental refugees: Myth or reality? New Issues in Refugee Research, Working Paper No. 34. Geneva: The Office of the United Nations High Commissioner for Refugees (UNHCR): Geneva.

Brown, O. (2008). Migración y Cambio Climático. *Serie Estudios de la OIM sobre migración*, No. 31. Geneva: IOM.

Cadena, M. de la. (1988). *Comuneros de Huancayo: Migración campesina en ciudades serranas.* Documento de trabajo Nro. 26. Lima, Peru: Instituto de Estudios Peruanos (IEP).

CAN (Andean Community of Nations) (2008). *El cambio climático no tiene fronteras: Impacto del cambio climático en la Comunidad Andina.* Available from http://www.comunidadandina.org/public/libro_84.htm.

CARE (2009). *Climate Vulnerability and Capacity Analysis Handbook.* First edition. Available from http://www.careclimatechange.org/cvca/CARE_CVCAHandbook.pdf.

CEPAL (Economic Commission for Latin America) (2011). *Anuario Estadístico 2011 [Statistical Yearbook for Latin America and the Caribbean]*. Santiago, Chile: CEPAL.

CEPES (Peruvian Center for Social Studies) (2007). *Estructura % de la PEA por actividad económica: 1950–2007.* Available from http://www.cepes.org.pe/portal/node/1926.

Cerrutti, M., and R. Bertoncello (2003). Urbanization and internal migration patterns in Latin America. Paper prepared for the Conference on African Migration in Comparative Perspective, 4–7 June, Johannesburg, South Africa.

CONAM (Peruvian National Environmental Council) (2005a). *Atlas Climático de precipitación y temperatura del aire en la cuenca del río Mantaro,* Vol. I. Lima, Peru: Comision Nacional del Ambiente (CONAM) and Instituto Geofísico del Peru (IGP).

_____________ (2005b). *Diagnóstico de la cuenca del río Mantaro, bajo la visión del cambio climático,* Vol. II. Lima, Peru: Comisión Nacional del Ambiente (CONAM) and Instituto Geofísico del Perú (IGP).

_____________ (2005c). *Vulnerabilidad Actual y Futura ante el Cambio Climático y Medidas de Adaptación en la Cuenca del Río Mantaro*, Vol III. Lima, Peru: Comisión Nacional del Ambiente (CONAM) and Instituto Geofísico del Perú (IGP).

Condom, T., Rau, P., and J.C. Espinoza (2011). Correction of the TRMM 3B43 monthly precipitation data over the mountainous areas of Peru during the period 1998–2007. *Hydrological Processes* 25, no. 12: pp. 1924–1933.

Diez, A. (1999). Organizaciones de base y gobiernos locales rurales: Mundos de vida, ciudadanía y clientelismo. In *Repensando la política en el Perú*, E. Bardález, M. Tanaka and A. Zapata, eds. Lima: Red para el desarrollo de las ciencias sociales, pp. 17–57.

Espinoza, J.C., and others (2006). *La variabilité des débits du Rio Amazonas au Pérou.* Climate Variability and Change: Hydrological Impacts (Proceedings of the 5th FRIEND World Conference, Havana, Cuba. International Association of Hydrological Sciences (IAHS) Publication No. 308, pp. 424–429.

Espinoza, J.C., and others. (2009a). Spatio-temporal rainfall variability in the Amazon basin countries (Brazil, Peru, Bolivia, Colombia, and Ecuador). *International Journal of Climatology* 29, No. 11, pp. 1574–1594.

____________ (2009b). Contrasting regional discharge evolutions in the Amazon Basin. *Journal of Hydrology* No. 375, pp. 297–311.

Foresight: Migration and Global Environmental Change (2011). *Final Project Report.* London: The Government Office for Science.

Gamero, J. (2006). Empleo en el Perú: diagnóstico y propuestas para el próximo gobierno. *Revista Economía y Sociedad*, Consorcio de Investigación Económica y Social (CIES) 59, Lima.

García Naranjo, A. (2007). *The Peruvian migration phenomenon.* Lima, Peru: Gender and Development Program. Centro de Asesoría Laboral del Perú (CEDAL).

Garreaud, R. and P. Aceituno (2001). Interannual rainfall variability over the South American Altiplano. *Journal of Climatology* No. 14, pp. 2779–2789.

Georges, C. (2004). The 20th century glacier fluctuations in the tropical Cordillera Blanca, Peru. *Arctic, Antarctic and Alpine Research* 36, No. 1, pp. 100–107.

Grupo de Trabajo Multisectorial (2008). *Diagnostico ambiental del Perú.* Lima, Peru: Preparación del Ministerio del Ambiente (R. M. No. 025-2008-PCM).

Haas, H. de (2003). *Migration and development in southern Morocco: The disparate socio-economic impacts of out-migration on the Todgha Oasis valley.* PhD thesis, University of Nijmegen.

INEI (Peruvian National Institute of Statistics and Informatics) (1994). *III Censo Nacional Agropecuario* 1994. Available from http://www.inei.gob.pe/biblioineipub/bancopub/Est/LIB0170/N58/IECJJ106.htm.

____________ (2008). *Perfil sociodemográfico del Perú.* Lima: Centro de Edición de la Oficina Técnica de Difusión del INEI. Available from http://censos.inei.gob.pe/Anexos/Libro.pdf .

____________ (2009). *Perú: Migraciones Internas 1993–2007.* Available from http://www.inei.gob.pe/biblioineipub/bancopub/Est/Lib0801/libro.pdf.

____________ (2011). *Evolución de la pobreza al 2010.* Lima, Peru: Informe Tecnico.

Inter-American Development Bank (2006). *Migrant remittances as a development tool.* Washington, DC: Multilateral Investment Fund (MIF).

IOM (International Organization for Migration) (2011). *Peru: facts and figures.* Available from http://www.iom.ch/jahia/Jahia/peru.

Kollmair, M. and S. Banerjee (2011). Drivers of migration in mountainous regions of the developing world: a review. *Foresight: Migration and Global Environmental Change Driver Review* 9. London: Government Office for Science. Available from http://www.bis.gov.uk/assets/foresight/docs/migration/drivers/11-1179-dr9-migration-in-mountainous-regions-developing-world.pdf.

Jäger, J., and others, eds. (2009). *Environmental change and forced migration scenarios project synthesis report.* Deliverable D.3.4 for the European Commission.

Lagos P., Silva, Y., and E. Nickl (2005). *El Niño y la Precipitación en los Andes del Perú.* Lima, Peru: Sociedad Geológica del Perú. Volumen jubilar en honor a Alberto Giesecke Matto.

Laczko, F., and C. Aghazarm, eds. (2009). *Migration, Environment and Climate Change: Assessing the Evidence.* Geneva and New York: IOM, UNU-EHS, CCEMA, Rockefeller Foundation.

Lavado, W., and others (2012). A basin-scale analysis of rainfall and runoff in Peru (1969–2004): Pacific, Titicaca and Amazonas drainages. *Hydrological Sciences Journal*, No. 57 vol. 4, pp. 1–18.

Leavell, D.N. (2008). *The consequences of climate change for the water resources of Perú.* Proceedings of the XIII World Water Congress, International Water Resources Association, Montpelier, France.

Magrin, G., and others (2007). Latin America. In *Climate change 2007: Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, and others, eds. Cambridge: Cambridge University Press, pp. 581–615.

Milan, A., Areikat, S., and T. Afifi (2011). Environmentally Induced Migration and Sustainable Development, UNDESA/DSD and UNU-EHS background paper, Paper presented at the special session on "Environmentally Induced Migration" of the 18th Annual Conference of the European Association of Environmental and Resource Economists, 29 June – 2 July 2011, Rome.

MINAM (Peruvian Ministry of Environment) (2010). *Segunda Comunicación Nacional del Perú a la Convencion Marco de las Naciones Unidas sobre Cambio Climático.* Lima, Perú: MINAM.

Morales, A.G.N. (2007). The Peruvian migration phenomenon. Gender and Development Program, Centro de Asesoría Laboral del Perú. Available from http://www.caritas-europa.org/module/FileLib/Naranjopanel1.pdf.

Morales Arnao, B. (2000). Los eternos nevados en el Perú están retrocediendo en forma cada vez más acelerada. In *El Medio Ambiente en el Perú*. Lima, Peru: Instituto Cuánto.

Municipalidad Provincial de Huancayo (2006). *Plan de Desarrollo Urbano Huancayo 2006–2011.* Available from http://bvpad.indeci.gob.pe/doc/estudios_CS/Region_Junin/huancayo/huancayo_PDU.pdf.

____________ (2009). *Mejoramiento y Actualización: Plan de Desarrollo Local Concertado Provincial 2007–2015.* Available from http://www.munihuancayo.gob.pe/portal/upload/documentos/2011/transparencia/00052.pdf.

Piguet, E. (2008). *Climate Change and Forced Migration: How Can International Policy Respond to Climate-Induced Displacement?* Geneva: UNHCR Evaluation and Policy Analysis Unit.

____________ (2010). *Linking climate change, environmental degradation, and migration: A methodological overview.* WIREs Climate Change, pp. 517–524.

Pulgar Vidal, Y. (1940). *Las ocho regiones naturales del Perú*. Dissertation, University of Lima, Peru.

Rademacher-Schulz, C., and others (2012). Rainfall variability, food security and human mobility: an approach for generating empirical evidence. Intersections No. 10. Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).

Renaud, F., and others (2007). Control, Adapt or Flee: How to Face Environmental Migration? InterSecTions No. 5/2007. Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).

Research Institute of Organic Agriculture (2011). *The world of organic agriculture 2011: key results.* Available from http://www.organic-world.net/yearbook-2011-key-results.html.

Ronchail J., and others (2006). *Impact of the Amazon tributaries on flooding in Obidos: climate variability and change – hydrological impacts.* Proceedings of the Fifth FRIEND World Conference, Havanna, Cuba, November. International Association of Hydrological Sciences (IAHS) Publication 308, pp. 220 – 225.

Salinger, M.J. (2005). Climate variability and change: past, present and future – an overview. *Climate Change,* No. 70, pp. 9 – 29.

Seimon, A. (2006). *Adaptation strategies to the environmental and socioeconomic impacts of El Niño for rural communities in Ecuador and Peru: climatological and meteorological contexts.* Consultancy Paper to the Climate Change Team. Washington, DC: World Bank.

Silva, Y., and others (2007). *Variabilidad de las precipitaciones en el valle del Mantaro. In Memoria del sub proyecto "Pronóstico estacional de lluvias y temperature del aire en la Cuenca del* *rio Mantaro para su aplicación en la agricultura"* (2007–2010). Lima, Perú: Instituto Geofísico del Perú (IGP), pp. 54–58

Silverio, W., and J.M. Jaquet (2005). Glacial cover mapping (1987–1996) of the Cordillera Blanca (Peru) using satellite imagery. *Remote Sensing of the Environment* 95, pp. 342–350.

Smith, C., and others (2008). Predictive modeling. *Forced Migration Review, Special Issue: Climate Change and Displacement,* 31, pp. 58-59. Oxford: Refugee Studies Centre.

Sperling, F., and others (2008). *Transitioning to climate resilient development perspectives from communities in Peru.* Washington, DC: World Bank, Environment Department.

Stal, M., and K. Warner (2009). The way forward: Researching the environment and migration nexus. Research Brief No. 2. Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).

Trenberth, K.E. (1984). Signal versus noise in the Southern Oscillation. *Monthly Weather Review,* vol. 112, pp. 326–332.

Trivelli, C., and others (2009). *Desarrollo Rural en la Sierra: Aportes para el debate.* Lima: Centro de Investigación y Promoción del Campesinado (CIPCA), Grupo de Análisis para el Desarrollo (GRADE), Instituto de Estudios Peruanos (IEP) and Consorcio de Investigación Económica y Social (CIES).

UCAR (University Corporation for Atmospheric Research) (2011). *Southern Oscillation Index (SOI).* Available from http://www.cgd.ucar.edu/cas/catalog/climind/soi.html.

UNDP (United Nations Development Programme) (2011). *Human Development Report 2011 – sustainability and equity: a better future for all.* Available from http://hdr.undp.org/en/reports/global/hdr2011/download/en/.

UNU-EHS (United Nations University Institute for Environment and Human Security) (2007). *EACH-FOR Research Guidelines.* Availabale from www.ehs.unu.edu/article/read/each-for.

United States Department of State (2012). *Background Note: Peru*. Available from http://www.state.gov/r/pa/ei/bgn/35762.htm.

Vuille M., and others (2008). Climate change and tropical Andean glaciers: past, present and future. *Earth-Science Reviews* 89, no. 3–4, pp. 79–96.

Warner, K. (2010). Global environmental change and migration: Governance challenges. *Global Environmental Change*, Special issue focusing on resilience and governance, vol. 20, pp. 402–413.

__________ (2011). Interdisciplinary approaches to researching environmental change and migration: Methodological considerations and field experiences from the EACH-FOR project. In *Handbook of Research Methods in Migration*, S. Castles, and others, eds., Oxford: Edward Elgar Publishing.

Warner, K., and others (2009). In search of shelter: Mapping the effects of climate change on human migration and displacement. A policy paper prepared for the 2009 climate negotiations. Bonn: United Nations University, CARE, and CIESIN-Columbia University and in close collaboration with the European Commission's Environmental Change and Forced Migration Scenarios Project, the UNHCR, and the World Bank

Warner, K., and others (2012). Where the Rain Falls: Climate Change, Food and Livelihood Security, and Migration. Global Policy Report. Analysis and Main Findings of the Where the Rain Falls Project. Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS) and CARE.

World Bank (2009). *Peru: country note on climate change aspects in agriculture*. Available fromwww.worldbank.org/lacagccnotes.

___________ (2012a). *Gini index by country.* Available from http://datos.bancomundial.org/indicador/SI.POV.GINI.

___________ (2012b). *GDP growth (annual %)*. Available from http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG.

WFP (World Food Programme) and Ministerio de la Mujer y Poblaciones Vulnerables (MIMDES) (2007). Evaluación de la situación de seguridad alimentaria en cuatro departamentos del Perú afectados por bajas temperaturas, Lima. Available from http://www.onu.org.pe/upload/documentos/PMA_Friaje.pdf.

Yamada, G. (2010). *Growth, employment and internal migration: Perú, 2003–2007*. Lima, Perú: Universidad del Pacífico.

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WHERE the RAIN FALLS

The Where the Rain Falls Project investigates how changes in rainfall interact with societies. The project provides a more nuanced understanding of the links between changing rainfall patterns, food and livelihood security, as well as migration in eight case study countries:

Bangladesh: Kurigram District, Rangpur Division
Ghana: Nadowli District, Upper West Region
Guatemala: Cabricán Municipality, Quetzaltenango Department
India: Janjgir-Champa District, Chhattisgarh State
Peru: Huancayo District, Junín Region
Tanzania: Same District, Kilimanjaro Region
Thailand: Thung Hua Chang District, Northern Thailand
Viet Nam: Dong Thap Province, Thap Muoi District.

Changing weather patterns are already causing weather extremes, including droughts and flooding, leading to food insecurity and displacement of people. Research results will help climate change policy and its implementation with important practical aspects to tackle poverty, protecting the most vulnerable people.

The full project findings – a research protocol, eight case study reports and a synthesis report for policymakers – are available at *www.wheretherainfalls.org*.