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# SUSTAINABLE LAND MANAGEMENT IN MOUNTAIN REGIONS OF BOLIVIA AND NEPAL IN THE CONTEXT OF OUTMIGRATION, CLIMATE CHANGE AND DISASTER RISK REDUCTION

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## Executive Summary - December 2014



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# 1 RESEARCH PLAN

## 1.1 PROBLEM STATEMENT

Worldwide land users are facing the challenge of producing from the land while minimizing natural resources degradation. Land management in mountains is furthermore constrained by steep slopes, inaccessibility, remoteness and often harsh climatic and weather conditions. Working on sloping land hampers mechanisation and thus requires more manual labour, and it requires special care to manage runoff caused by heavy rains, and related soil erosion and mass movements. Mountain areas also depend on difficult road constructions to access markets and centres. But there are advantages, such as access to sufficient water, higher (although sometimes excessive) rainfall than in lowlands or often very adapted, traditional and rich socio-cultural systems which evolved over thousands of years. These systems are neither fixed nor isolated from globalization, and out-migration has always been an adaptation strategy of mountain societies.

The mountain ecosystem can be particularly sensitive to the dynamics of human activities, but also to changing climatic conditions. Although climate change and environmental degradation as drivers of migration has been widely studied (Piguet 2013), there is a gap in the literature on how migration impacts on land management, and the implications climate change and increasing disaster occurrence have on sustainable land management. While migration research is often focused on those who migrate or their places of destination (Black et al. 2011; Findlay 2011; Piguet 2013), land management studies on the other hand tend to consider land user families as a complete and stable unit (Hurni 2000; de Graff et al. 2008). It is therefore crucial to have a detailed look at how land management is sustained under changed population and climatic conditions, as a loss of care might promote devastating events, such as floods or landslides.

## 1.2 RESEARCH OBJECTIVE

The original research objective was stated as: *to explore the interface between people and mountain dynamics under a context of climate change in order to develop policy recommendations for development land management and livelihood strategies, disaster risk reduction and implementation of climate adaptation plans.* The research question guiding this project is *“How is land management in mountains being affected by three main factors: migration, climate changes (temperature and rainfall patterns) and hazard events in Quillacollo District of Bolivia and Panchase region of Western Nepal, and which measures are needed to increase resilience of livelihoods and land management practices?”.*

## 1.3 HYPOTHESES

The original hypothesis was that climate change is creating additional land and water management problems and increasing mountain hazards. Secondly that out-migration is leading to a feminization and ageing of mountain populations who are less able to address needed changes in agricultural practices, water management, landslides and flooding. To narrow down the research, the second year focused on the second hypothesis, with two focused research questions:

1. What is the impact of migration on land and water degradation, especially with regards to land abandonment?
2. What is the impact of migration on land management practices? This includes interrogations about the use of remittances for agricultural purposes and implementation of sustainable land management practices.

## 1.4 METHODOLOGY

The study integrated bio-physical and socio-economic data through a case study as well as a mapping approach. From the social sciences, well-tested qualitative methodologies, typically used in vulnerability and capacity analyses, such as semi-structured interviews with so-called 'key informants', focus group discussions and transect walks, were conducted. The bio-physical analysis of the current environmental conditions determining hazards and structural vulnerability were obtained from remote sensing analysis, field work studies, and GIS analysis (Figure 1).

WOCAT (World Overview of Conservation Approaches and Technologies) is a methodology as well as a world wide database of sustainable land management practices to which this project contributed. WOCAT data collection methods include stakeholder consultations and mapping of conservation and land management approaches and technologies. The database is publically available.

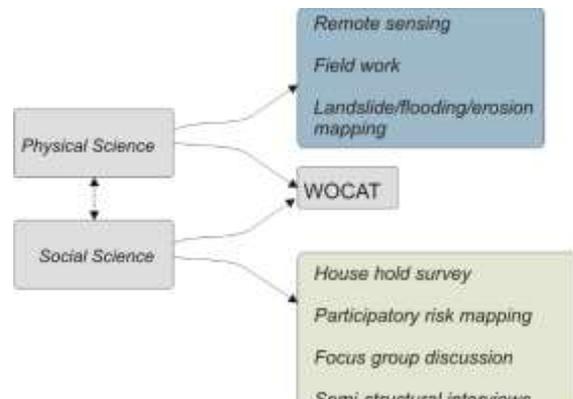


FIGURE 1. TRANSDISCIPLINARY RESEARCH METHODOLOGY

## 1.5 SCHEDULE AND ACTIVITIES UNDERTAKEN

### 1.5.1 BOLIVIA

The first field trip was conducted in July/August 2013. The objective was to collect baseline information. The second field trip was in July/August 2014 to collect more in-depth data and to organize two workshops and one information exchange meeting with the local authorities.

Activities undertaken during that field trip were aimed at covering all the aspects of the project, to conduct and determine:

- The scope of the study area, collection of field data and discussion with inhabitants.
- A literature review, satellite image interpretation and field work survey in order to identify landscape processes, land uses and land management.
- A household semi structured questionnaires: 26 households survey in 4 different villagers following a random sampling at 10% of the households of each community.
- A participatory map and group discussion based on the interpretation of satellite images and field data with community people.
- WOCAT workshop (cancelled).
- Meeting with the Municipality of Sipe Sipe to exchange information on SNIS project results, after which a report on project activities was sent to the Mayor of Sipe Sipe.
- Science-Policy workshop in La Paz organized by Helvetas Swiss IC. This workshop brought together scientists and experts on migration issues with policy makers to discuss SNIS study findings and policy implications.

### 1.5.2 NEPAL

A first field trip was conducted in March 2013 with the objectives of choosing the study sites and obtaining a first overview on the issues related to out-migration, land management, disaster and climate change. The second field trip to Nepal was conducted January-March 2014, with the goal to collect in-depth field data and map the area. A third visit was made to accompany the SNIS documentary film team and to organize the Science-Policy workshop (Oct-Nov. 2014).

Activities undertaken during the field trips were aimed at covering all the aspects of the project, to conduct and determine:

- The scope of the proposed study areas.
- A preliminary characterization of the land degradation and existing sustainable land management measures.
- A test of the semi-structured questionnaires and application with 91 interviewees in 7 different villages following a structured sampling at 28% of the households of each community.
- The implementation of initial focus group discussions and participatory mapping data.
- Activities in Jan-March 2014: The application of the WOCAT mapping methodology on the study area to map and understand the land degradation and land management practices present in the area.
- Filming of a documentary with SNIS staff on the impacts of outmigration on land management in October – November 2014 for release in 2015.

Three workshops were organized in Nepal:

- WOCAT workshop at IUCN in Kathmandu (Feb. 2014) aimed at presenting WOCAT, its aims, network and tools, especially the WOCAT mapping methodology. The audience brought together scientists, non-governmental organisational and government officials. The workshop was followed by a training for local level experts, project scientists and community members and concluded with an initial verification workshop in Pokhara.
- WOCAT Seminar presentation at Institute of Forestry, Pokhara (March, 2014). The seminar brought together students, researchers, professors and local government officials and helped to verify the outcomes of the mapping data collection.
- Science- Policy workshop in Kathmandu, (November 3, 2014). This workshop brought together scientists, government officials, civil society organizations to discuss the SNIS workshop findings, other research on the topic and policy implications. (See Annex 3).

## 2 RESULTS

The study areas were selected considering the following criteria: out-migration, harsh environmental conditions, and land management issues; but also where local partners had experience from previous projects to facilitate channels of communication with local the people and building on their past experiences.

### 2.1.1 BOLIVIA

The study area is located in the Quillacollo district (Sipe Sipe village), situated in the central part of Bolivia (Figure 2). The research was conducted in the Jatún Mayu watershed from Sipe Sipe locality. This is one of the poorest areas in the Cochabamba department, with

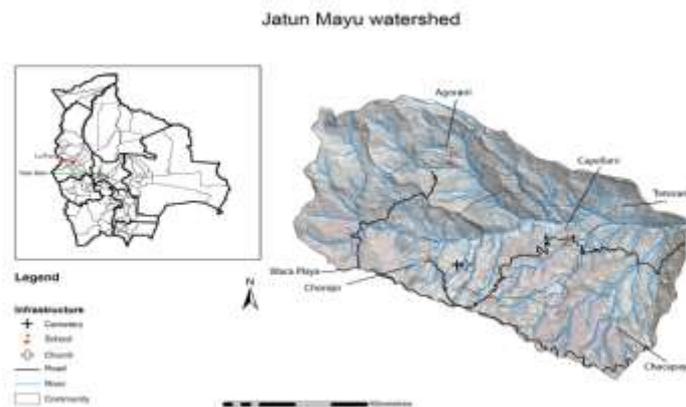


FIGURE 2. SITUATION MAP –JATUN MAYU WATERSHED, COCHABAMBA BOLIVIA

high out-migration rates, and harsh environmental conditions (Penna et al., forthcoming). In the sub-Andean region, the rainy season takes place between November to March. Both partners, AGRUCO, based in

Cochabamba and Helvetas/Intercooperation, based in La Paz have considerable research experience from this area. The climate is semi-arid (640 mm/year on average) with shallow soils.

### ***Physical processes***

The area is subject to several types of severe erosion: aeolian erosion, gully erosion and shallow and deep seated landslides that are reducing the amount of arable lands, more difficult soil conditions and access. This is reducing agricultural production and creating a hazard to the population (Figure 3). The combination of vegetation removal and wind erosion increases soil degradation during rainfall events, creating more erosive run off. It is likely that human activities, mainly uncontrolled grazing and poor farming practices have greatly contributed to land degradation, exacerbating natural erosion. However, it was also observed that landslides occurrence strongly relates to the many natural factors, especially fluvial incision in the Jatún Mayu river sector (Penna et al, submitted).

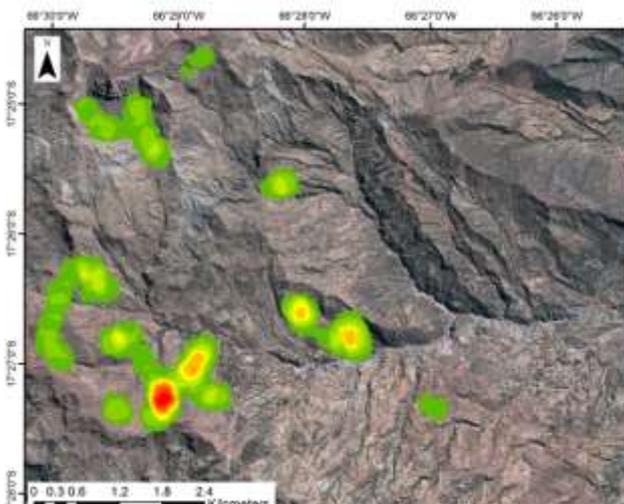


FIGURE 3. FIRST STAGE GULLY DENSITY MAP IN THE STUDY AREA. RED COLOR INDICATES HIGHER DENSITY. ARCGIS LINE DENSITY TOOL, RADIUS OF 500 METRES.

Climatic events are also affecting agricultural activities and production in the watershed. Frost events have always occurred, mainly in the upper part of the watershed whereas hail affects the entire area. Although frost events are used for the production of Chuño (dried potato generated by frosts), unexpected/out of season events lead to losses of production. These uncertainties about frost periods and more extreme weather, especially drought, are attributed to climate change and are an increasing concern for the population surveyed (Penna et al, submitted). Communities manifested also a loss of predictability as a consequence of the rupture in the transfer of knowledge on weather related processes based on bio-indicators.

### ***Socio economic characteristics and migration***

The population surveyed all belong to the Quechua indigenous group. The main language is Quechua, although young people also speak fluent Spanish. Migration is a common and traditional coping strategy in the Andean livelihoods to sustain households and provide food. In the studied watershed the migration rate is high and has increased over the past decades (INE 2011). Among the 26 households surveyed, 73% have at least one household member who has migrated within Bolivia. The young population is the most prone to leave the community as they seek better working opportunities and better lives. Main migrants consist of young male and female adults (below 35 years). There is no marked trend of feminization in the area even though more men migrate. Three of four schools in the area have closed (Agorani, Capellani, Totorani) and children remaining in those communities have to go to school in Sipe Sipe or Sique Siquía. The main migration destinations are mainly within Bolivia, i.e. people are moving to the valley in Sipe Sipe (36% of the migrants) (the closest large town) Santa Cruz (12%), the Chapare (9%) and Cochabamba (6%) where facilities are better. The economy of Santa Cruz is expanding rapidly and Chapare is well known for its coca production, one of the main industries in Bolivia. A majority of those who migrate to the closest areas maintain double residency (one in the valley and one in the

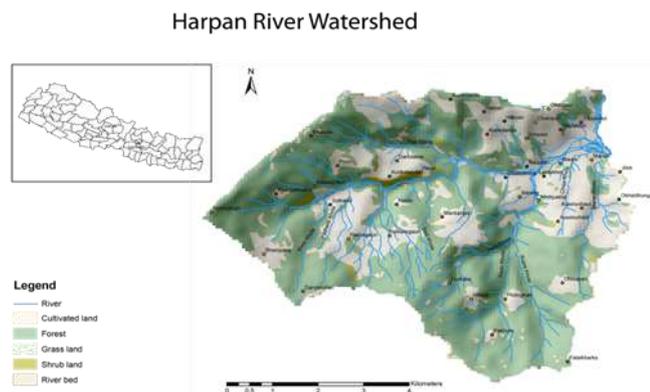
mountain community). The population remaining in mountain villages continues to work their land parcels, however some of the men leave for temporary migration (12% of the migrant, during some weeks to months) to Chaparé during low season (for the agriculture) for cash or to purchase consumer items.

### ***Links between land management and migration***

As mentioned above, there is a clear decrease of the labour force in our survey area because of out-migration, especially of the young generations. Some of the families living in the valley below are commuting to ensure basic work on the land parcels. Thus, according to our survey results and observations, accessible and/or productive lands are being maintained but officially, land is not being abandoned. This point was difficult to establish formally due to the reluctance of people to speak about this topic as it raises sensitive issues about land tenure. This new way of life has led to less time for agriculture and land management, which used to be the principle activity. The main impacts of migration on overall land management and control of erosion seems to be reduced labour force to work the own land, to maintain community services (water canals, roads, etc.), and disruption of the knowledge transfer for predictability of weather related events. In the area surveyed, the main sustainable land management (SLM) practices included structural and vegetative measures (e.g. grass strips, check dams made of piled stones and wood, and gabion walls). They were and are set up by the communities and governmental agencies and tend to reduce the impact of natural processes driving to soil erosion.

#### ***2.1.2 NEPAL***

The study area is located in the Panchase area, Western Development Region of Nepal, considered the water tower of the Phewa watershed and Lake (Figure 4). The altitude in the Panchase area ranges from 800 m to 2517 meters above sea level. The climate is sub-tropical with an annual rainfall of 4,500 mm and thick soils. There area has 15,964 households with a population of 62,001 (District Development Profile of Nepal, 2012). Climate change impacts include longer drought periods and more intense monsoon rains, which are leading to an increase in landslides, erosion and flooding (Petley, 2012).



**FIGURE 4. SITUATION MAP - HARPAN RIVER WATERSHED, KASKI DISTRICT, NEPAL**

### ***Physical processes***

Landslides in the area produce on-site and off-site effects on agricultural lands, which are difficult to restore once damaged. In downstream Harpan, people noted that 55 years after debris inundation it is still difficult to recover lands for agricultural purposes. Land is directly washed away by landslides, buried during landslide deposition and due to sediment charges of currents during rainy season. In addition, increasing amounts of sediments transported downstream by currents have an impact on populations settled close to the mouth of these rivers. Often those settlements are recent and constituted by people that have migrated from the mountains towards the lowlands. Many shallow landslides and gully erosion are due to unmanaged road construction which has expanded considerably in recent years (Leibundgut et al, forthcoming) and have strong links to migration, as migrants are creating a higher demand for roads. However, the WOCAT

mapping revealed that only 1.3% of the area and only 2.8% of the cropland are affected by soil erosion (loss of topsoil and gullying) and the trend is decreasing slightly on average (Schwilch et al, forthcoming, Jaquet et al forthcoming).

### ***Management - mitigation measures***

The major SLM measures applied are forest management (afforestation, forest protection) on 34% of the area (50.7% of the forest) and terraces on 14% of the area (52.4% of cropland). Community forest management has a long tradition in Nepal. Additionally, there is the Panchase Protected Forest which is a protected area since 2011. According to several interview partners, the protection of the forest was effective in reducing the landslide problems in the forest and thus also in reducing damages on the adjacent cropland. During field work we also observed different practices to cope with and mitigate landslides. Amongst them are gabion walls, which are very widely used yet not so well constructed, situated and maintained (e.g. in some cases they are installed during the dry season and are washed away during the monsoon). Gabion walls are also the most demanded measures by locals to protect infrastructure. They are not expensive to install as communities usually receive wire netting upon request for installing the gabion walls themselves. Agroforestry with coffee plantations has been established in the area with very good economic benefits, in addition to some vegetable farming for the market.

### ***Socio economic characteristics and migration***

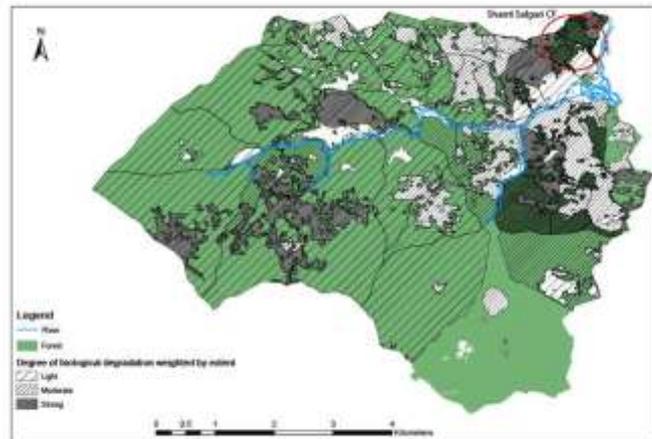
The survey covers 569 inhabitants in 91 households within 7 different communities. The households are located in Kaski district. The main part of the population studied is from the Gurung group (Indigenous), Brahmin group (Hindu) and Dalit (Hindu) and Chhetri (Hindu). The area is very mixed due to the high mobility of the population, which was one of the first to migrate abroad. In the area studied 67% of the households surveyed have at least one member living somewhere else in Nepal (elsewhere in Nepal or in Kaski district) or abroad. Migrants are mainly men of 20-45 years old leaving behind women, children and the elderly. The hypothesis of our work is clearly confirmed here, the migration leads to a feminization of the area, a leading factor causing changes in land use patterns and livelihoods strategies. Destinations outside Nepal are mainly within Asia or in the Middle East. India is the first destination for migrants but nowadays Gulf countries are becoming major destinations, mainly Qatar, Saudi Arabia and Dubai, followed by Malaysia, Korea and Bahrain. Over the past decade, the percentage of international migrants from Nepal has increased from 3.2% to 7.3% (Sharma et al. 2014). This is considered a very negative trend according to officials, local leaders and interviewees, due to the loss of manpower. There is also a localized phenomenon of families shifting from upper watersheds downstream and closer to main road access (Jaquet et al., forthcoming).

### ***Links between land management and migration***

According to findings from the household survey, the number of men living abroad and sending remittances is very high (86% of household with at least one migrant are receiving remittances). The women left behind manage traditional women's tasks (raising the children, taking care of the house and the livestock) in addition to taking on traditional male work, principally field work. The consequences are multiple: women are overburdened with traditional female work (taking care of the children, house and livestock) in addition to work traditionally not allowed (by their religion and culture) such as roofing and ploughing the land, yet enabling women to take on greater responsibilities and allowing for greater economic and political empowerment (Ghimire and Upreti 2012; Schwilch et al., forthcoming).

The lack of labour is also increasing the financial burden on women. To be able to care their land they have to hire scarce labour staff with high wages, placing a strain on household resources. With 22% of arable lands abandoned in the study area, land abandonment is an important consequence of migration (Jaquet et al., forthcoming) and perhaps the most important findings of this study. Results showed that the first lands to be abandoned are those furthest away from settlements, rainfed terraces and those with lowest productivity. Abandoned terraces are covered by grasses, bushes and trees within a very short time due to the favourable ecosystem recovery conditions. According to our findings, erosion due to land abandonment has not increased, except possibly on some land 1-2 years after abandonment and before plant recolonization (Jaquet et al., forthcoming).

Main consequences of land abandonment are an increase in forest cover, estimated at 12% of the area studied since 1996; reduced land fertility as less manure and labor are available to according to respondents; and a significant increase in invasive species in abandoned terraces. According to our findings, 39.2% of the land use for agriculture purpose of the study area is affected, mainly by Nilo Gandhe (*Ageratum Houstonianum*) and Banmara (*Ageratina adenophora*) (Figure 5), and these two plants only appeared 5 and 10 years ago respectively. Nilo Gandhe is toxic for animals and both are difficult to remove. Fertility decline and reduced organic matter content is a problem on 32.1% of the cropland. This was clearly related to out-migration, which has reduced the number of animals and thus the availability of manure as well as the manpower to distribute the manure.



EXTENT (JAQUET ET AL, FORTHCOMING)

Main SLM practices in the area studied included structural, vegetative and agronomic measures (e.g. forest management measures such as Community Forestry (CF), terraces and gabion walls). Terraces maintenance has decreased due to lack of labour, although the fast recolonization of shrubs enabled reduction of erosion processes that may have resulted from degrading terraces.

### 3 ANALYSIS

#### 3.1 MATCH BETWEEN EXPECTED RESULTS AND RESULTS OBTAINED

Our first hypothesis linked climate change with additional land and water management problems while increasing mountain hazards. After one year of research, our findings demonstrated that climate change effects are certainly important and provide *the context* in which land management issues are changing yet in different ways in the two countries. This study did *not* attempt to focus on the degree to which climate change acts as a push factor as in reality there are a number of both push and pull factors that lead to migration as coping strategy. In the second year, we thus focused research on the second hypothesis: migration is leading to a feminization and ageing of mountain populations who are less able to address needed changes in agricultural practices, water management, landslides and flooding.

Research in the second year demonstrated that this hypothesis is confirmed in Nepal but not in Bolivia, where entire families are migrating, or commuting mainly to nearby urban

centres. However a more elderly and vulnerable population is increasing in both areas, where the traditional social fabric no longer provides the same support to the elderly. At the same time, there are positive outcomes through greater female empowerment and the additional income received through remittances. In areas studied in Nepal, results demonstrated that land abandonment is causing *less* erosion, except during the transition period before natural regeneration occurs after the first two years (Jaquet et al, forthcoming).

In our study areas of Bolivia, land abandonment was not confirmed due to the highly sensitive nature of land tenure questions, but a lack of labour force has led to changed agricultural and land management practices. However, drought and wind erosion appear to be increasing due to a lack of land management (Penna et al., submitted).

### **3.2 PRACTICAL APPLICATION OF RESULTS**

With different physical characteristics (geology, rainfall, vegetation cover, climate change) yet similar socio-economic issues (out migration, lack of infrastructures, education), the question of sustainable land management practices is crucial in both areas but potential solutions differ. Our preliminary findings strengthen our postulate that links between human and natural environment in the context of outmigration are highly linked and relevant and that migration has led to both negative and positive consequences in the areas studied. Positive consequences include strengthening of coping capacities, higher household income due to remittances, access to education and employment, in addition to possibly greater women empowerment and expanded opportunities for marginalized low caste groups in Nepal.

However, out-migration appears to have negative consequences on the social fabric, where the elderly were traditionally cared for by younger families. Migration is also leading to a loss of local knowledge about land management, and land abandonment, thus not necessarily exerting a positive influence on sustainable land management practices. In both locations, climate change is increasing the frequency and magnitude of extreme weather events, by shifting crops (and invasive species) upslope and making less certain the traditional planting season due to more erratic temperatures and rainfall. In light of these trends, the challenge for the populations studied will be how to manage land considering changing demographics, uncertain climatic conditions, less available labour and lower food production in mountain areas. There is an obvious shift from local food production to greater reliance on remittance income and food importations.

## **4 QUESTIONS THAT MERIT FURTHER RESEARCH**

This research has addressed most of the initial research questions to satisfaction but leave us with new questions related to the consequences of migration and sustainable land management.

- Is migration increasing or decreasing resilience in rural areas over the long-run in case of lower demand for migrant labor in cities and abroad?
- Can migration lead to a food security crisis when less food is produced locally and replaced with imported food?
- How will land tenure issues change to accommodate land abandonment in Nepal, perhaps leading to the need for land reform?
- To what extent are remittances used for climate change adaptation/ disaster risk reduction and what are the incentives for households and communities to invest more in these activities?

## **5 PRACTICAL AND POLICY RECOMMENDATIONS**

Both Science-Policy workshops pointed to the need for migration as a necessary coping strategy but one that is not considered sustainable in the long run, as it does not

necessarily lead to sustainable development of the agricultural sector in support of food security issues. Some of the most important policy issues that emerged which link migration, climate change, disaster risk reduction and sustainable land management in both countries include:

- Promoting local employment creation and supporting agriculture through extension and skills training especially targeting the younger population. This includes a concern for maintaining food production locally while addressing issues of declining soil fertility and invasive species.
- Creating an enabling environment for returnee migrants in terms of skills development and entrepreneurship, especially targeting female skills development for left behind women.
- Facilitating migration and migrants rights through awareness campaigns on both negative and positive effects of migration.
- Addressing climate change impacts and disaster risk reduction through Integrated Watershed Management approaches may increase resilience of rural populations.
- Ensuring effective communications through sustainable development of rural roads to promote safe transportation for migrants and promote easy access to facilities and markets.

## **6 PROJECT OUTCOMES AND OUTPUTS**

- Two policy briefs were prepared by partners in Nepal and Bolivia and shared with workshop participants.
- A press release was developed after the Nepal Science- Policy workshop and sent to media.
- A report on main study findings was sent to the Sipe-Sipe Municipality.
- An international science conference was organized in Lausanne, December 2-4 with co-funding from the University of Lausanne, Faculty of Geoscience and Environment, which led to a book to be published by Springer in 2015, entitled: "LINKING SUSTAINABLE DEVELOPMENT, GLOBAL MIGRATION, CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION – IDENTIFYING EMERGING ISSUES FOR POLICY AND PRACTICE".
- Project findings were incorporated in the baseline study for the current parallel project, "Ecosystems Protecting Infrastructure and Communities" (EPIC) on "Eco-safe roads in Panchase region of Nepal" 2013-2016, UNIL-ISTE.
- A documentary film on the Nepal project is being produced (funded separately by SNIS).

## **7 ACKNOWLEDGEMENTS**

Many thanks to University of Berne, CDE for co-funding of PhD Stéphanie Jaquet's salary during the SNIS project as well as enabling her to complete her third year PhD. Thanks to the Quanterra and Herbette Foundations for economic support to develop the last field work in Bolivia, to UNIL-ISTE for covering many other international tickets and to the Ecosystems Protecting Infrastructure and Communities (EPIC) project for covering partial travel expenses during the scoping study and to R. Rodriguez for logistics during the 2014 Bolivia field work.

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## LIST OF ANNEXES

ANNEX 1. List of people involved in Field work and workshop activities during the project period.

<b>Nepal</b>	<b>Bolivia</b>
Ms. Stephanie Jaquet (UniBe)	Dr. Ivanna Penna (UNIL)
Dr. Karen Sudmeier-Rieux (UNIL)	Ms. Stephanie Jaquet (UniBe)
Dr. Gudrun Schwilch (UNIBe)	Mr. Raoul Kaenzig (UniNe)
Dr. Ivanna Penna (UNIL)	Mr. Edgar Cuba (AGRUCO)
Ms. Anu Adhikari (IUCN-Nepal)	Ms. Angelina Machaca (AGRUCO)
Mr. Sanjaya Devkota (FEED Ltd, Nepal)	Dr. Javier Gonzales (Helvetas Swiss IC)
Ms. Gitta Shrestha (NCCR-Nepal)	Dr. Esther Halidmann (Helvetas Swiss IC)
Dr. Bishnu Upreti (NCCR- Nepal)	Prof. Michel Jaboyedoff (UNIL)
Mr. Rajendra Khanal (IUCN-Nepal)	Jean-Marie Vuignier (UNIL)
Prof. Michel Jaboyedoff (UNIL)	

ANNEX 2. Bolivia Science- Policy workshop policy brief

ANNEX 3. Nepal Science- Policy workshop policy brief

ANNEX 4. Nepal Science- Policy workshop summary

ANNEX 5. Meeting with Sipe-Sipe Municipality report