

IMPACTS OF OUT-MIGRATION ON LAND MANAGEMENT IN MOUNTAIN AREAS OF NEPAL AND BOLIVIA

Schwilch G.¹, Adhikari A.², Cuba E.³, Jaboyedoff M.⁴, Jaquet S.¹, Kaenzig R.⁵, Liniger HP.¹, Machaca A.³, Penna I.⁴, Sudmeier-Rieux K.⁴ and Upreti B.⁶

¹*Centre for Development and Environment CDE, University of Bern, Switzerland,*

²*International Union for Conservation of Nature IUCN, Kathmandu, Nepal*

³*Agroecología Universidad de Cochabamba AGRUCO, Bolivia*

⁴*Group of Risk Analysis – Institute of Earth Sciences (ISTE), University of Lausanne, Switzerland*

⁵*Institute of Geography, University of Neuchâtel, Switzerland*

⁶*Nepal Center for Contemporary Research NCCR, Kathmandu, Nepal*

ABSTRACT

This study examines the impacts of migration on land management in mountain areas of Nepal and Bolivia. Migration to cities and abroad is increasingly leaving behind half families and the elderly. Livelihoods as well as the management of land are affected by a change of labour force, traditional knowledge, remittances and other consequences of migration. In this study we explored how the land and its management is affected by those issues and what are the measures and strategies taken by the population left behind in two sub watersheds of Nepal and Bolivia. The WOCAT mapping methodology was used to assess land management practices and, in combination with a variety of other research methods, it helped to understand the impacts of migration on land degradation and conservation. Preliminary findings reveal negative as well as positive impacts. In Nepal, the main degradation problem found were invasive alien plant species, whereas the overall vegetation and forest had increased and some types of degradation, such as soil erosion or landslides, were even reduced. A feminization of agriculture was observed in the Nepali case study, whereas at the Bolivian site whole families are migrating and, on the contrary, mostly men are temporarily returning to manage the land. The findings of this study suggest that a more differentiated view is required when looking at the impact of migration on land management.

Key words: Sustainable land management, migration, impact, land degradation, Bolivia, Nepal

INTRODUCTION

Study objectives

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 (Warner et al, 2010; 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, Gisladdottir and Stocking 2005, 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. This chapter focuses on these potentially negative, but also positive impacts on the land, such as from remittances which might improve living conditions or facilitate financing new land management measures.

The aim of the study was to identify how land management in mountains is being affected by migration in two study sites, namely Quillacollo District of Cochabamba in Bolivia and Panchase area from the Western Development Region of Nepal. More specifically, through the assessment of land use, land degradation, sustainable land management practices, migration patterns, use of remittances and concerns of the population left behind, the study contributes to an improved understanding of the population and land dynamics in those areas. This chapter presents preliminary findings from the field campaigns, with a stronger focus on the results from the Nepali case study, because not all the field assessments were conducted in both sites yet.

Conceptual framework

The study is based on two complementary conceptual frameworks: The sustainable livelihoods framework (SLF) and the sustainable land management (SLM) framework. The SLF framework (DFID, 1997; Scoones, 1999) defines livelihoods as access to five basic capitals or resources (social, human, economic, natural and physical) and is considered the standard approach to understanding livelihoods and vulnerability (Upreti and Muller-Boker, 2010; Turrall, 2011). The SLM framework (UNU-INWEH, 2011; Schwilch et al., 2011) provides an overview of the cause – effect interactions of land degradation and SLM on environment and human well-being. Sustainable land management is considered the ‘response’ to the ‘drivers’, ‘pressures’ and ‘states’ of degradation, which enhances the provision of ecosystem services and thus improves human well-being and reduces poverty. The two frameworks are combined to explore the impact of migration on land management and livelihoods.

Access to resources, environmental degradation, mountain hazards/climate change and changing demographics are the identified drivers of change. They can be in a causal relationship and are, each in itself or combined, creating more vulnerability and strains on livelihood strategies. Those strategies are then leading to a change in land management or increasing out-migration. Adapted livelihood and land management strategies can in turn have an impact on the access to resources or on environmental degradation and hazard events, especially in fragile environments such as mountains.

Disasters and climate change impacts

Disasters and climate change are adding a new dimension to land management in mountain areas. Models of climate change are uncertain at best, however data on monsoon rains point toward more intense rainfall patterns, longer drought periods and new higher ranges for crops (Sudmeier- Rieux et al., 2012). Data analysed by Petley (2010) show the South Asian Seasonal Monsoon Index (SASMI) correlated with a higher incidence of landslides since 1995. Drought spells are now more common and the crops can grow at higher and higher elevations. According the testimony of inhabitants from different regions in Bolivia, the incidence of hail storms and drought has increased (Oxfam 2009). Such natural hazards, also including wind storms, frost, landslides and floods, can further aggravate

the vulnerability of mountain communities and mountain farming (Kollmair and Banerjee 2011, Haller 2012, Milan and Ruano 2014). The uncertain climate conditions, which have been noticeable over the past ten years, have obviously created more uncertainty for managing the land, especially as mountain farming communities are now heavily impacted by loss of labour due to migration.

Migration impacts

Migration has been an adaptation strategy by mountain people in the past. Recently, this mobility has increased, related to rural poverty, environmental degradations, enhanced communication means, higher education, changing values, and rising economies attracting thousands of migrant workers, such as Qatar and other gulf countries in the case of Nepal (Seddon et al. 2002, Anderson 2002, Jodha 2005, Shrestha and Bhandari 2007, Zoomers 2012).

Demographic changes induced by partial migration of single family members and economic factors such as remittances influence the natural resources management of those left behind (Gartaula et al. 2012, Kollmair et al. 2006, Maharjan et al. 2012). It has been shown that for example land abandonment is a growing consequence of out-migration (Paudel et al., 2012, Khanal and Watanabe, 2006), but many other impacts of migration on land management are not clear yet. That is what this study wants to shed light on. Migration is leaving behind half families and elderly to deal with managing the land alongside daily life challenges (Grau and Aide 2007, Black et al. 2011). A potential reduction of labour force as well as expertise on land management practices on cropland, grazing, forest, and mixed land, such as maintenance of terraces and irrigation canals or stabilization of slopes, are further challenged by changing climate conditions and increased environmental threats (Jokisch 2002, Gray 2009, Valdivia et al. 2010). On the other hand, remittances might help households to invest in more sustainable agricultural practices besides supporting livelihoods through purchasing food and goods, affording better schools, etc. (Davis and Lopez-Carr 2010, Nijenhuis 2010, Deshingkar 2011).

Sustainable Land Management

Sustainable land management (SLM) is a holistic and integrated concept which has emerged from soil and water conservation over the past twenty years, integrating technical and ecological aspects as well as economic and socio-cultural dimensions (Hurni et al. 2006, Schwilch et al. 2011). The World Overview of Conservation Approaches and Technologies (WOCAT) network and programme defines SLM “as the use of land and water resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions” (WOCAT 2014). Based on this definition, SLM practices should not only be ecologically compatible, but also economically viable and socially acceptable. As such, SLM has the capacity to directly address all three UN environmental conventions. It helps to prevent desertification (UNCCD), to increase biodiversity (UNCBD) and to make people less vulnerable to the effects of climate change (UNFCCC). In addition, it plays an important role in mitigating climate change through improving soil organic matter and increasing vegetation cover. Although many of these positive effects of SLM are known, it is insufficiently evaluated in what way SLM is impacted by migration and in a context of disasters and climate change.

METHODS

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. Some of the methods are outlined in more detail below.

In Nepal, the assessment of the consequences of migration in the area of origin was linked with a mapping and appraisal of land management practices (Schwilch et al. 2011). The WOCAT mapping tool (Liniger et al. 2008) allows capturing the major land degradation as well as land management practices / technologies, their spread, effectiveness and impact within a selected area. Data drawn from a variety of sources is compiled and harmonised by a team of experts, consisting of land degradation and conservation specialists working in consultation with land users from various backgrounds. The specialists' and land users' knowledge is combined with existing datasets and documents (maps, GIS layers, high-resolution satellite images, etc.) and verified in workshops with the above mentioned stakeholders. The workshops are designed to build consensus among the participants regarding the assessment of land degradation and SLM. This process is also referred to as participatory expert assessment or consensus mapping. In the Panchase area in Western Nepal the WOCAT mapping tool was applied in the Harpan river sub-watershed in the Kaski district, an area of 36 km². A land use map of the Phewa catchment area, of which the Harpan watershed is part of, served as a base map. It was produced by the local NGO (Machhapuchhre Development Organization) using *rapid eye* satellite image of 2012. With the help of local experts and field visits, each land use type of 48 administrative units (12 wards with further subdivisions along landscape features) was assessed individually regarding land use trend, land degradation and land management by filling in the attribute tables of the WOCAT mapping tool. In Bolivia, field survey mapping and remote sensing supported the identification of land degradation and SLM.

Finally, the mapping was used together with other socio-economic data to combine information about migration types and land management issues. In order to obtain this data, a household survey was conducted within the watersheds in six and four communities in the Nepali and Bolivian sites respectively. Swiss, Nepali and Bolivian researchers jointly designed and tested the questionnaire based on previous knowledge and research conducted in Nepal (Sumeier-Rieux et al 2011) and adaptations to the Bolivian context (e.g. land tenure issues, vocabulary). The questions centred around household demographics and socio-economic status, housing and infrastructure, land use and land management, damages from disasters, migration situation, remittances, institutional and social issues including main concerns. Between 10 and 30% of the households were thus surveyed using a systematic sampling method. These data was complemented through interviews, focus group discussions and expert consultation. GIS and descriptive statistical analysis as well as content analysis of the qualitative data were used to understand, quantify and visualize those links. Not all the data has been analysed yet for the current chapter, as research is still ongoing.

STUDY AREAS

The study areas were selected considering the following criteria: out-migration in the proximity to an urban centre, harsh environmental conditions, and land management issues. For the outmigration, national statistics were consulted. To identify harsh environmental conditions, relief and geomorphology were analysed, referring to processes which are shaping the landscape, causing intense erosion or are occurring at a rate that challenge the capacity of people to deal with their dynamics. Information about land management included available knowledge about sustainable land

management practices from within the local partners and previous projects (e.g. NEPCAT¹, EbA² projects from IUCN in Nepal, PROMIC³ and other projects from AGRUCO in Bolivia).

The study area in Nepal is located in the Panchase area, more specifically the Harpan river sub-watershed in the Kaski District, Western Nepal, near the city of Pokhara. With a precipitation of 4000 mm per year and altitudes ranging from 800 m to 2517 m.a.s.l., the area is considered the water tower of the Phewa watershed and Lake. The climate is sub-tropical and soils are usually thick. Based on data from the Department of Survey (GoN 2012), the estimated number of households for the sub-watershed is 894, with 3330 persons in total and 93 persons/km². Major non climate pressures include over-exploitation or unsustainable use of resources, overgrazing and pest infestation, whereas climate induced pressures include habitat destruction, biodiversity loss, increase in invasive alien plant species and degrading ecosystem functioning (EbA project 2014). The Panchase region is one of the most affected by landslides in Nepal, with high out-migration, creating a severe and underreported impact on food security and sustainable local development (Sudmeier-Rieux et al. 2011). In Nepal, migration is a common strategy to improve the livelihoods. Migrants are mostly men and they migrate to other Asian countries, first to India and then to the Gulf countries (NIDS and NCCR North-South 2011).

The study area in Bolivia is located in the Quillacollo district (Cochabamba Department), situated in the central part of Bolivia. The research is being conducted in the Jatún Mayu-Pankuruma watershed from Sipe Sipe municipality. This is one of the poorest areas in the Cochabamba department, with high out-migration rates, and harsh environmental conditions. The climate is semi-arid with an annual rainfall of only 600 mm and mostly thin soils. In the sub-Andean region, the rainy season lasts from November to March. The area suffers from severe land degradation mainly due to landslides, fluvial erosion, wind erosion and the formation of gullies, leading to a loss of land and productivity. Furthermore, there is an increasing unpredictability of extreme climatic events, such as frost and hail episodes. Based on the last population census from the National Institute for Statistics (Instituto Nacional de Estadística, INE 2012), there are 465 inhabitants in the four studied communities (Chorojo, Capellani, Acorani, Chacapaya). Population density is only 30 persons/km² and the household size is on average around 4 persons. (INE, 2012). In the mountainous regions of Bolivia, migration is a common and a traditional strategy to adapt to the harsh environmental conditions. It is mostly young men after finishing primary school who leave the community to seek working opportunities outside the climatic dependant agricultural sector.

RESULTS PANCHASE NEPAL

Migration, people's concerns and use of remittances in Panchase, Nepal

81% of the 58 households surveyed have at least one member, mostly men and young people, living somewhere else in Nepal or abroad. Due to cultural and legal barriers, only a few women are also migrating abroad (Ghimire and Upreti 2012), they rather move to main Nepali cities when they can afford it.

Persons interviewed in the different areas prioritized their main concerns according to a list of proposed choices. Unemployment is the main priority (Fig. 1) which appears logical according to the significant out-migration rates in those villages. Health / sanitation, road access and education are also important concerns. Landslides and flooding are only a minor problem, mainly mentioned by the most

¹ Nepal Conservation Approaches and Technologies, <http://www.icimod.org/nepcat>

² Ecosystem Based Adaptation Programme, Nepal, <http://ebaflagship.org/ecosystems/mountains/nepal>

³ PROgrama Manejo Integral de Cuencas (Integrated watershed management programme), Bolivia. http://www.promic-bolivia.org/index_esp.php

affected families of Harpan and Ghatichina. Concerns regarding agriculture rank very low: farming issues and access to land and water are considered problems of a lower priority.

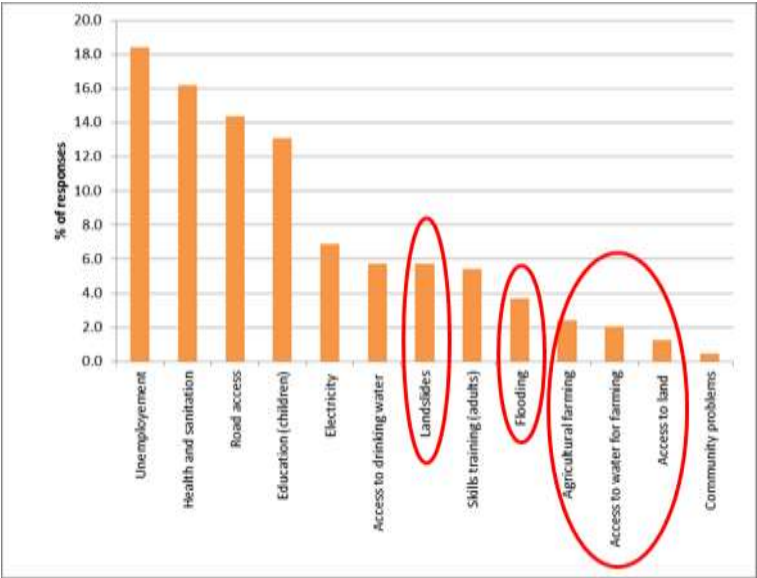


Fig. 1: Main concerns mentioned by 58 household respondents in Panchase, Nepal (the 5 main concerns were weighted by their rank).

This might not be surprising when considering that agriculture has become a smaller part of household income with 78% having more than 50% of off farm income. Many households mainly live from and depend on remittances, whether in the form of financial or material support, which are used primarily for food and education. The analysis revealed that remittances are hardly used for agricultural purposes (Fig.2).

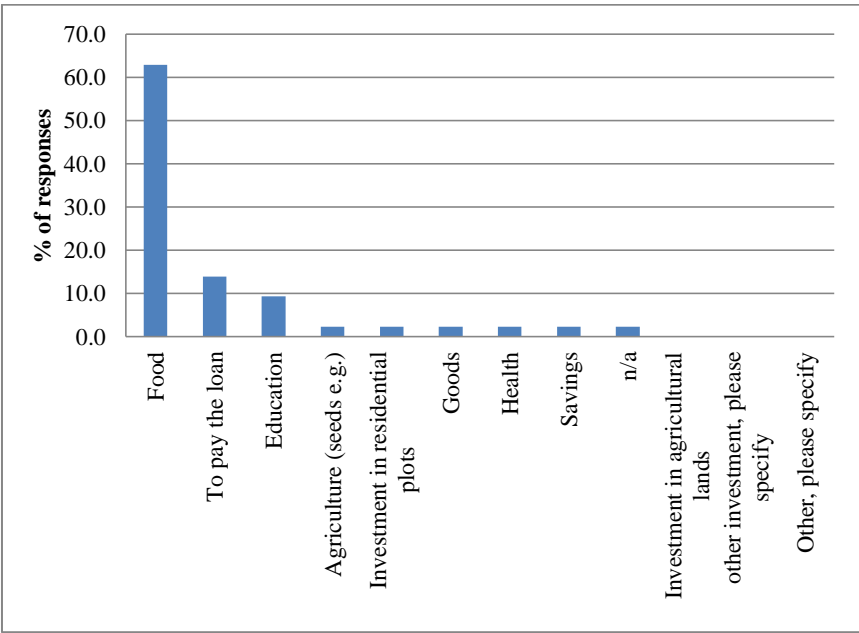


Fig. 2: First use of the remittances (including financial and material support) by the households who receive remittances in Panchase, Nepal

Land degradation and land abandonment in Panchase, Nepal

Forest is the main land use of the watershed, covering more than 70% and being located mainly in the upper West and South part of the watershed. Since 1996, a net increase of forest of over 12% due to abandonment of cropland was measured (Jaquet et al, forthcoming). The irrigated (*Khet*) and non-irrigated (*Bari*) agricultural fields make up 26% of the watershed and are located in the central and lower Eastern parts. According to Jaquet et al (forthcoming), almost 22% of the cropland area is currently being abandoned.

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. Abandoned terraces are covered by grasses, bushes and trees within a very short time due to the favourable ecosystem recovery conditions. A woman from Upper Makwanpur says: “*Abandoned land is stronger now through trees, not fragile anymore*”. Even when grazed, there were very few signs of damage on the terrace risers, such as shown in Fig 3. The damages seen of Fig. 3a and Fig. 3b represent rare exceptions and most interview partners confirmed this impression from the field survey. Deteriorations due to grazing on abandoned terraces are also minimized because there are fewer animals in the villages. The terraces still in use for agriculture are usually well maintained, i.e. manure is applied (Fig. 3c) and, where necessary, terrace risers are enforced by stone walls (Fig. 3d).



Fig. 3: Terraces are usually well maintained. Damages on terraces, whether abandoned or not, are rare. a) animal trampling on abandoned terraces, b) mice holes in terrace riser, c) application of manure, d) terrace riser reinforced with stones (Photos: G. Schwilch)

It is often assumed that less land management and abandonment of terraces would lead to more soil erosion. The results of this study showed the contrary or at least a more differentiated picture. The

field survey and mapping, the interviews as well as the focus group discussions did not reveal any increased soil erosion problems from agricultural or forest land.

An exception to this statement is road constructions causing increased erosion and shallow landslides. Within the Harpan sub-watershed, damage from road constructions, e.g. soil deposits on the land just underneath, was visible in a few cases only, but a detailed assessment was not done. However, related studies (Raya and Sharma, 2008; UNDP, 2012) in the surrounding areas refer to huge problems with badly planned and negligently implemented road constructions. A majority of rural earthen roads are funded partially by local government authorities (Village Development Committees) and partially by communities themselves. They are usually constructed using a local bulldozer contractor with no technical or geological expertise. Such roads are commonly wiped out during heavy monsoon rains, requiring costly clearing with heavy equipment and increasing landslide risk and impacts to settlements, forests, water sources, agriculture lands, and infrastructure (Oven et al. 2008).

The main degradation type in the area, resulting from the WOCAT mapping, is biological degradation, more specifically the increased spread of invasive alien plant species. 39.2% of the studied area is affected, mainly by Nilo Gandhe (*Ageratum Houstonianum*) and Banmara (*Ageratina adenophora*), and these two plants only appeared 5 and 10 years ago respectively. Nilo Gandhe is toxic for animals and both are difficult to remove. The resource persons participating in the mapping clearly link this degradation type to out-migration and land abandonment, as illustrated by these two statements: “*If we would have more people in the village, we would have less invasive species, as these people would use the land*” (man in Kuiredanda village) and “*The more Banmara is cleared, the more it grows; the labour availability is the restriction to clear it better*” (woman in Upper Makwanpur). The problem is that Banmara can spread vegetatively and thus it might even become worse, if weeding is not done extremely carefully or plant pieces are dropped randomly. Thus, with land abandonment and less labour available for weeding, both species spread increasingly (see also Jaquet et al. forthcoming).

Fertility decline and reduced organic matter content is a problem on 8.4% of the area, more specifically on 32.1% of the cropland. The mapping resource persons as well as the interview partners clearly related this 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. On the other hand, it was also said that “*Fertility has increased because land is used less*” (focus group participant in Upper Shidane), meaning that they had to reduce from two crops a year to only one crop per year due to lack of labour. Leaving out the second crop, e.g. maize in case of irrigated rice-based cropping fields (*Khet*) or millet in the rainfed maize-based system (*Bari*), will increase fertility due to less extraction of nutrients. However, this might not be significant and would need to be further investigated. Around Ghatichina, the village to which some households from upstream migrate, the cropland suffers from declined fertility due to increased population and thus an increase from two to three crops per year.

It is worth noting that 50.6% of the total area does not suffer from any land degradation. In the forest, this value is as high as 61.9%, whereas only 23.7% of cropland is unaffected by degradation.

If we consider the total extent of degradation per map unit (Fig 4a), pressure on the natural resources is higher in the lower, more densely populated sectors of the watershed in the west as well as in most cropland units. The upstream areas and especially the eastern part of the catchment are much less affected. It is, as shown above, mainly the forest units which show very little degradation, where less than 10% is affected. A similar picture is given when showing the extent of SLM measures applied, see Fig 4b. The map units having a high extent of degradation are often also having a high extent of SLM measures. Based on the interviews, this can be explained by the higher population density in the downstream areas, reinforced by the out-migration of upstream, remote areas to these lower sectors of

the watershed. This supports the hypothesis that abandoned land due to out-migration is not increasing land degradation problems (see also discussion and conclusions).

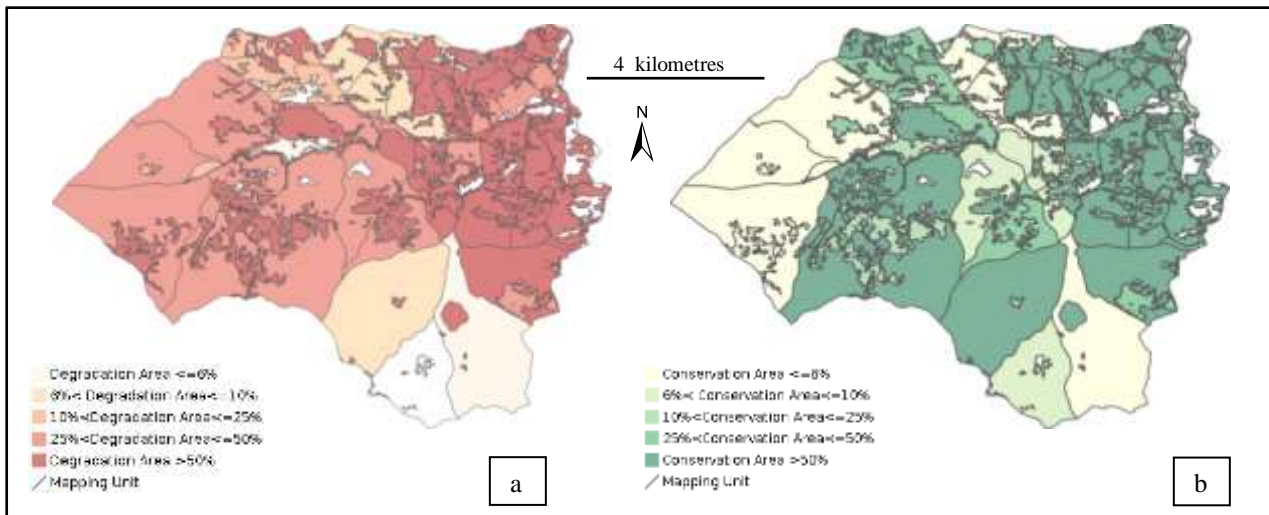


Fig 4: Comparison of the total extent of degradation (a) and of SLM measures (b) per map unit, showing that areas having a high extent of degradation are often also having a high extent of SLM measures.

Sustainable Land Management in Panchase, Nepal

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 (Adhikari et al. 2004). Families have access to these community forests which are imposed by specific rules about use and management and are steered by community forest user groups. Additionally, there is the Panchase Protected Forest which is a protected area since 2011 (Panchase Protected Forest Program, Ministry of Forest and Soil Conservation). 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.

Overall, the forest cover has increased between 1996 and 2012 by 12% (Jaquet et al, *forthcoming*) and the pressure on the forest resources has decreased at the same time. In the words of a woman from Upper Shidane the link with outmigration and land abandonment is nicely illustrated: “*With abandoned land we have access to fodder and don’t need to go to the forest. Also with better stoves we use less fire wood from forest*”. But this consolidation of the forest resource has some disadvantages for the remaining population and their cropland. Several people reported increased problems with monkeys, rats and other wild animals affecting the crops.

Almost all crops are grown on terraces. When asked about SLM practices applied in the area, terraces are often not mentioned by the people, just because they are so normal in Nepal. However, they are highly effective against land degradation, especially soil erosion. Besides traditional terracing being maintained, only few new SLM practices are emerging, such as vegetable farming, mulching or agroforestry.

Overall, 53% of the land in the Harpan sub-watershed has some kind of SLM practice (49.3% of forest, 59.7% of cropland). Beside forest management and terracing, these include nutrient management, protection against natural disasters (such as gabions walls with vegetative measure, 1%) and grazing land management (0.6%) (Jaquet et al. *forthcoming*).

Social impacts of outmigration and land abandonment in Panchase, Nepal

54.3 % of the households interviewed have abandoned lands and the main reason mentioned is the lack of labour availability (Jaquet et al. forthcoming). Some of the cropland cannot be cultivated anymore because of lack of labour, but also because of gender issues. Asked about problems when women manage the land, a representative from Lower Makwanpur responds: “*Yes, there is a big problem for the women to plough. Some of the abandoned lands are from these women. It is abandoned because they cannot cultivate it*”. The women left behind are overburdened with additional male work, which traditionally/culturally they are not allowed to do, such as ploughing or roofing. Although women face problems of cultivating land because their male family member have migrated, women are also empowered in terms of overall management of land as they have to make decision and they are forced to deal with different the actors of the land (like Village Development Committee VDC, government officials, etc.).

The majority of the inhabitants cannot see any positive side of land abandonment. On the contrary, they regret that the land is not cultivated anymore and complain that “*wild animals hide there*”. Also the social life in the villages suffers. Several of the remaining villagers expressed really feeling like left-behinds. A woman from Lower Shidane pointed it that way: “*If they have money, they migrate – we don’t have money, so we are here*”.

RESULTS QUILLACOLLO BOLIVIA

Migration and people’s concerns in Quillacollo, Bolivia

Due to fewer field assessments conducted in Bolivia, e.g. no WOCAT mapping, the results presented here rely on the analysis of the household survey, semi-structured interviews, field mapping and group discussions.

In Bolivia, mountain communities are characterized by a high level of mobility which is a traditional and well-established way in Andean livelihoods to reduce vulnerability to both environmental and non-environmental risks (Kaenzig and Pigué 2014). Consequently, most of the households are involved in a process of multi-residency and/or circular migration at various scales (local, national, international). This could be confirmed in the study area, where whole families are migrating downward to main urban centres such as Sipe Sipe, Quillacollo or Cochabamba, or to other departments, especially to Chapare (tropics) for the coca production and to Santa Cruz. Some young people are migrating abroad, mostly to Argentina. While the migration abroad is mostly long term, the migration to another department is more temporary and the employment in neighbouring cities is found to be through a flexible form of multi-residency and commuting. Returnees can also be found, as there is no real rupture with the place of origin. There are few remittances and if those are sent to the families in the mountain areas, then they are mainly used for agriculture purpose.

Fig. 5 shows that environmental hazards in Bolivia are high up in the list of major concerns of the population. Landslides and the difficulties with agricultural farming under threats like hail and frost are even the most important concerns. Health and sanitation, unemployment, electricity and education are also very important issues in this area. From the five communities in the watershed, only one primary school is still working, and in order to access to secondary school or university, students have to move downstream to Sipe-Sipe or Cochabamba. The lack of basic education is increasingly putting pressure on people, pushing them to move and to leave the mountains.

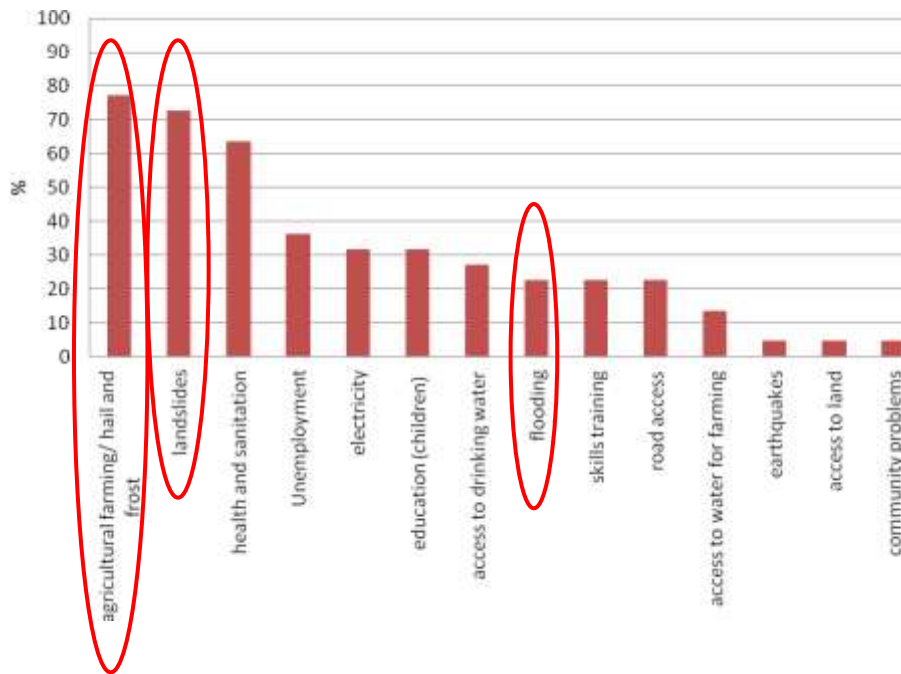


Fig. 5: Main concerns mentioned by 22 household respondents in three communities from the Jatún Mayu-Pankuruma watershed, Quillacollo district, Bolivia

Identified drivers of outmigration include environmental factors (such as uncertainties of extreme weather events), income insecurity related to the agricultural production, the desire for cash-paid jobs, the request of the youth to benefit from a higher education and the migratory network. Differences within the watershed can be depicted in terms of altitude, higher villages having a different migratory pattern than lower villages.

Land degradation, SLM and impacts of migration in Quillacollo, Bolivia

Land degradation observed in this study is mostly related to soil erosion by water and wind, strong fluvial incision which leads to landslides, loss of topsoil through surface erosion and gullies. The effects of gully development on agricultural lands and infrastructure (e.g. roads) can be massive (Fig. 6). An additional threat to farming is hail and frost, occurring mainly during autumn and winter.



Fig. 6. Impacts on roads and agricultural lands due to gully erosion (Photos by I. Penna).

SLM measures practiced in the area are terraces, gabion walls and grass strips as detailed in Table 1. The table is structured according to the WOCAT system and reference is made to case studies from the WOCAT database (http://qt.wocat.net/qt_report.php) documented by PROMIC.

Name	SLM Group (Type of measure)	Purpose	Effectiveness	Impacts	Case study in WOCAT database
Terraces	Protection against natural hazards (Structural measure)	Mitigation of soil erosion by water: loss of topsoil / surface erosion and mass movements / landslides	Moderate	Increased production, regulation of excessive water, reduced damage of private and public infrastructure, reduced land availability (area of land for production per person)	Muros de Piedras para Terrazas de Formación Lenta (T_BOL03es)

Gabion walls	Protection against natural hazards (Structural measure)	Mitigation of soil erosion by water: gully erosion / gullying, riverbank erosion	Moderate	Increased production, increased land availability, improved soil cover (vegetation, mulch, etc.), increased net income, reduced damage of private and public infrastructure	Obras Hidráulicas - Gaviones de Piedras (T_BOL009es)
Slow forming terraces with grass strips (Phalaris and elephant grasses)	Vegetative strips / cover (Vegetative measure)	Mitigation / prevention of loss of topsoil / surface erosion	Good	Increased production, improved soil cover (vegetation, mulch, etc.), enhanced soil formation (including wind-deposited soils), enhanced food & livelihood security and net income, reduced poverty	Barreras Vivas, (T_BOL002es)

Table 1: Applied conservation measures in the area

The impacts of migration on land management practices are not fully clear yet, but there are some important aspects emerging from the information obtained during the interviews. Double-residence migrants are still using their land and coming back some days to work on it. However, as a consequence of this multi-residency, there is a tendency to reduce land management work or to change the way the land is used. Because of their decreasing capacities to exploit lands due to labour force shortages, people are concentrating agriculture on most accessible/productive parcels. These uncultivated areas are, as stated by a member of the Agorani community, often the ones with the steepest terrain and more difficult access, although less affected by fluvial erosion and landslides. Whether land is being completely abandoned is unclear due to the reluctance of people to speak about land tenure with outsiders like researchers. Inhabitants only obtained the right to own their land and crops since the agrarian reform that took place in 1952 and land property has remained a very sensitive issue since then due to their fear of losing their rights again.

During fieldwork, and contrary to the initial hypothesis, it was observed that there is no substantial process of feminization in the study area in Bolivia, rather the whole family is migrating. Most families are migrating to the valley of Cochabamba or within Bolivia and the men (sometimes with their wives) are returning to the mountain to maintain fields or to participate in community meetings. They also have to accomplish their duties (“*cargos*”) for the community. These are responsibilities and roles that are shared among the community members, such as the role of the community leader, organised in a turn over system of one year. To remain a member of the community it is crucial for the villagers to accomplish their duty. Remittances are not common and most of the time, family members return with food or consumer items. The main phenomenon observed relates to population ageing. Migration leads to a loss of traditional knowledge regarding farming, but also leads to changing the traditional plantation calendar, which is becoming more difficult to maintain due to uncertain climate predictions. Indeed, the analysis showed that younger farmers are losing knowledge about natural weather indicators and subsequent agricultural measures, which is leading to loss of agricultural production. Additionally, the decrease in labour force is leading to a lack of maintenance of agricultural lands and increased problems with land management, possibly leading to increased land degradation.

DISCUSSION

Through the assessment of land use, land degradation, sustainable land management practices, migration patterns, use of remittances and concerns of the population left behind, this study has contributed to an improved understanding on how land management in mountains is being affected by

migration in the two study sites. We first discuss our interpretation from bringing these issues together for each site and then provide some insights from comparing both sites. The asset of this study was the possibility to bring together the land management and livelihood/migration domains. This goes beyond other studies, which focus either on the migratory livelihoods only, or neglect changed family patterns when evaluating land management, as presented in the introduction.

Our preliminary interpretations of in the Panchase area in **Nepal** shed light on the strong link of migration and land management. Even within a rather small watershed like the Harpan river sub-watershed in the Panchase area, there are areas of out-migration as well as in-migration. Whereas they are linked and interdependent through the people migrating from one place to the other, the consequences on the land are very different.

We have identified five causal consequences of **out-migration**, which are all in a cause-impact relationship by themselves:

1. **Less human population** results in a reduced number of livestock in the villages. This means that less manure is produced to fertilize the soils.
2. **Labour shortage** due to population decrease has several impacts: First, the reduction to only one crop per year leads to reduced income (as more food has to be bought). Second, cropland terraces are not cultivated anymore and thus abandoned. Third, invasive alien plant species are increasing on abandoned terraces.
3. **Land abandonment** provides better access to more fodder, initially from better access to grazing land and forage grass, later from the grown up woodland. It does thus not need to be sought from the forest anymore.
4. **Less land degradation** due to less intensive use of resources. An important exception here is the massive increase of invasive alien plant species. But soil erosion is generally decreasing, while vegetation cover is increasing.
5. **Expansion of forest**, with a likely increase of biodiversity and wildlife (again, partly threatening the cropland).

The finding of Paudel et al (2012), that the labour shortage resulting from out-migration is the major constraint for the agricultural activities, leading to changes in the cropping patterns, is confirmed by our study. Farmers are either shifting towards a single crop per year because of labour shortage or even prefer to abandon their land in favour of wage labour providing them with less risky and more immediate benefits.

As there are also areas of **in-migration** in the Harpan sub-watershed, especially the downstream village of Ghaticina and surroundings, we were able to identify and consider these impacts there as well:

1. **More population** leads to more pressure on land resources in in-migration villages.
2. More people on **less land** require cultivating an additional crop, i.e. an increase from two to three crops per year.
3. **Increase of the intensity of land use** leads to decreasing soil fertility and to potentially less careful land management, such as cultivating crops which require less post-harvest processing, such as potatoes. Potatoes are potentially increasing soil erosion due to the heavy soil disturbance during harvest.

Through the application of the WOCAT mapping in Nepal, there is also a methodological conclusion beside the topical one. The preliminary findings above were presented to a group of local, regional and national stakeholders during a small workshop in Pokhara directly at the end of the field survey. The aim was to verify the data and trigger some discussions on the conclusions. This was only possible

because the WOCAT mapping method allowed entering data online and viewing resulting maps immediately. As such, the maps as shown in Fig. 4 were directly taken from the mapping database and were shown to the participants of the workshop in Pokhara. It is where the major strength of the WOCAT method can be seen, overcoming some of its shortcomings, such as a rather rough assessment and some potential bias of resource persons. Because the Pokhara workshop also served as a mean to verify the field data, it enabled to level out some of these biases in assessment. Participants of the workshop and the field work later acknowledged the methodology for its potential to influence policy makers through these ready-made maps and that the results produced immediately after field work were very convincing and motivating to all involved.

In **Bolivia**, the study is less advanced and results are even more preliminary. In Quillacollo, we found four types of migration: long term (abroad), temporary (to another department), commuting and multi-residency (to neighbouring cities) and return migration. It is a very mobile society and there is no rupture with the communities of origin. Migrants usually stay in close touch with the mountain villages and turn back on a regular basis, whether it is to maintain their plots of lands or to accomplish their responsibilities and roles that are shared among the community members. But as a consequence of migration schools are closing or become centralised, traditional and rural knowledge is lost and conflicts over land tenure emerge. These impacts are then becoming drivers and push factors of migration on their own.

Some important questions remain, such as what are the causes of the intense gullying, i.e. is grazing a major cause of degradation? And do people really abandon their land and if so what are the impacts on it? In Bolivia, it is difficult to distinguish the fallow land and the abandoned land as land abandonment is a sensitive issue.

The contexts of two case studies are very different; however in both areas, mostly young people are outgoing from the mountains and leaving behind half families and elderly to manage the land. Additionally in both cases unemployment and education are major reasons for moving out, even though the causes are not always the same. More specifically, in the case of Nepal, the use of remittances underlines the fact that investment in agriculture is not the first choice of a family. In the case of Bolivia, the findings showed that people have a dynamic mobile way of life between the urban areas and communities of origin in the mountains and that they continue to work on their lands even if they move downward. What is striking is that in Bolivia, environmental threats are the most important concerns, while in Nepal these figured only in the seventh rank and beyond.

CONCLUSIONS

The findings of this study suggest that a more differentiated view is required when looking at the impact of migration on land management. For example in Nepal, there was no evidence to prove an often assumed effect, namely the negative impact of out-migration on land degradation. On the contrary, some types of degradation, such as soil erosion or landslides were even reduced and overall vegetation and forest had increased. But other types of land degradation, such as increased invasive alien plant species, emerged at the same time, threatening the agricultural activities of the left-behinds. The main negative effect is a socio-cultural one, as the livelihood of these people is not only affected by the ecological environment of the land on which they live, but much more by the absence of their family members and neighbours. This is threatening the social fabric and leading to a loss of traditional knowledge and cultural customs. A feminization of agriculture was observed in the Nepali case study, whereas at the Bolivian site whole families are migrating and, on the contrary, mostly men are temporarily returning to manage the land.

It is this interaction of livelihoods and land which characterises the high dynamism of these mountain areas.

REFERENCES (not formatted yet)

- Adhikari, B., Di Falco, S., & Lovett, J. C. (2004). Household characteristics and forest dependency: evidence from common property forest management in Nepal. *Ecological Economics*, 48(2), 245-257. doi: <http://dx.doi.org/10.1016/j.ecolecon.2003.08.008>
- Andersen, L., E. (2002). Rural-Urban Migration in Bolivia: Advantages and Disadvantages. *Documento de Trabajo*, 5(02).
- Black, R., Adger, W. N., Arnell, N. W., Dercon, S., Geddes, A., & Thomas, D. (2011). The effect of environmental change on human migration. *Global Environmental Change*, 21, Supplement 1(0), S3-S11.
- Black, R., Bennett, S. R. G., Thomas, S. M., & Beddington, J. R. (2011). Climate change: Migration as adaptation. [10.1038/478477a]. *Nature*, 478(7370), 447-449.
- Davis, J., & Lopez-Carr, D. (2010). The effects of migrant remittances on population - environment dynamics in migrant origin areas: international migration, fertility, and consumption in highland Guatemala. *Population and Environment*, 32(2-3), 216-237.
- de Graaff J, Amsalu A, Bodnár F, Kessler A, Posthumus H, Tenge A. 2008. Factors influencing adoption and continued use of long-term soil and water conservation measures in five developing countries. *Applied Geography* 28 (4): 271-280. doi:10.1016/J.Apgeog.2008.05.001.
- Deshingkar, P. (2011). Are there examples of remittances being used to build local resilience to environmental change, especially through investment in soil and water conservation or broader agriculture? London: Government Office for Science UK.
- EbA project, 2014. Ecosystem and Ecosystem Services of Panchase: An overview. Department of Forests, Kathmandu: Nepal
- Findlay, A. M. (2011). Migrant destinations in an era of environmental change. *Global Environmental Change*, 21, Supplement 1(0), S50-S58.
- Gartaula, H. N., L. Visser & A. Niehof (2012) Shifting perceptions of food security and land in the context of labour out-migration in rural Nepal. *Food Security*, 4, 181-194.
- Ghimire A, Upreti BR. 2012. Migration, Mobility and Development: Enhancing Our Understanding in Nepal, SAs RCO Discussion Paper 6. Kathmandu: South Asia Regional Coordination Office of National Centre of Competence in Research North-South and Nepal Centre for Contemporary Research.
- Gisladottir G, Stocking M. 2005. Land degradation control and its global environmental benefits. *Land Degradation & Development* 16: 99-112.
- GoN, 2012. National Population and Housing Census 2011. Central Bureau of Statistics, Kathmandu: Nepal
- Grau, H., & Aide, T. (2007). Are rural-urban migration and sustainable development compatible in mountain systems? *Mountain Research and Development*, 27(2), 119-123.
- Gray, C. (2009). Rural out-migration and smallholder agriculture in the southern Ecuadorian Andes. *Popul Environ*, 30, 193-217.
- Haller, A. (2012). Vivid valleys, pallid peaks? Hypsometric variations and rural-urban land change in the Central Peruvian Andes. *Applied Geography*, 35(1-2), 439-447.
- Hurni H. 2000. Assessing sustainable land management (SLM). *Agriculture, Ecosystems and Environment* 81: 83-92.
- Hurni, H., M. Giger and Meyer, K. 2006. Soils on the global agenda. Developing International Mechanisms for Sustainable Land Management. International Union of Soil Science: Bern
- INE 2012. Instituto Nacional de Estadística, Bolivia
- Jaquet S., Schwilch G., Hartung-Hofman F., Adhikari A., Sudmeier-Rieux K., Shrestha G., Liniger H.P. Mapping land management within the context of land abandonment and out migration in Harpan sub watershed, Kaski district, Western Nepal (forthcoming)
- Jodha, N. S. (2005). Adaptation strategies against growing environmental and social vulnerabilities in mountain areas. *Himalayan Journal of Sciences*, 3(5), 33-42.
- Jokisch, B. D. (2002). Migration and agricultural change: The case of smallholder agriculture in highland Ecuador. *Human Ecology*, 30(4), 523-550.
- Kaenzig, R. and Pigué, E. 2014. South & Central America and the Caribbean. In: *People on the move in a changing climate: comparing the impact of environmental change on migration in different regions of the world*. Eds. Pigué, E. and Laczko, F. Published by IOM and Springer.
- Khanal, R., & Watanabe, T. (2006). Abandonment of Agricultural Land and Its Consequences. *Mountain Research and Development*, 26(1), 32-40

- Kollmair, M., & Banerjee, S. (2011). Drivers of migration in mountainous regions of the developing world: a review. London: Government Office for Science UK.
- Kollmair, M., S. Manandhar, B. Subedi & S. Thieme (2006) New figures for old stories: Migration and remittances in Nepal. *Migration Letters*, 3, 9.
- Liniger H.P., van Lynden G., Nachtergaele F. and Schwilch G. 2008: Questionnaire for mapping land degradation and sustainable land management (QM). WOCAT, LADA, DESIRE: CDE Bern, FAO Rome, ISRIC Wageningen, pp 45. <https://www.wocat.net/en/methods/spatial-assessment-qm/questionnaires.html>
- Maharjan, A., S. Bauer & B. Knerr (2012) International Migration, Remittances and Subsistence Farming: Evidence from Nepal. *International Migration*.
- Milan, A., & Ruano, S. (2014). Rainfall variability, food insecurity and migration in Cabricán, Guatemala. *Climate and Development*, 1-8.
- NIDS and NCCR North-South. 2011. Nepal Migration Year Book 2010. Kathmandu. Nepal Institute of Development Studies and National Centre of Competence in Research-North-South. ISBN: 978-9937-8112-6-2.
- Nijenhuis, G. (2010). Embedding international migration: the response of Bolivian local governments and NGOs to international migration. *Environment and Urbanization*, 22, 67-79.
- Oven, K., Petley D., Rigg J., Dunn C., Rosser N. 2008. Landslides, livelihoods and risk: vulnerability and decision-making in Central Nepal. *Proceedings of The First World Landslide Forum, 18-21 November 2008, United Nations University, Tokyo, Japan.*
- Oxfam International in Bolivia (2009) Bolivia: Climate Change, Poverty and Adaptation (London, United Kingdom: Oxfam International, October); available at: <http://www.oxfam.org/sites/www.oxfam.org/files/boliviacclimate-change-adaptation-0911.pdf>
- Paudel Krishna P. Dahal Dipankar, Shah Racchya. 2012. Study Report on Abandoned Agriculture Land in Mid hills of Nepal – Status, Causes and Consequences. ACIAR/ICRA, ForestAction Nepal, IUCN Nepal.
- Petley, D. N. 2010. On the impact of climate change and population growth on the occurrence of landslides in Asia. *Quarterly Journal of Engineering Geology and Hydrogeology*, 43 (4): 487-496.
- Piguet, E. (2013). From “primitive migration” to “climate refugees” - The curious fate of the natural environment in migration studies. *Annals of the Association of American Geographers* 103(1), 148-162.
- Raya, R. B and Sharma, S. 2008. Impact of Landuse in Water Quality of Phewa Lake, Pokhara, Nepal. Sengupta, M and Dalwani, R. Editors. *The World Lake Conference: 703-716*;
- Seddon, David, Jagannath Adhikari, and Ganesh Gurung. "Foreign labor migration and the remittance economy of Nepal." *Critical Asian Studies* 34.1 (2002): 19-40.
- Schwilch G., Bestelmeyer B., Bunning S., Critchley W., Herrick J., Kellner K., Liniger H.P., Nachtergaele F., Ritsema C.J., Schuster B., Tabo R., van Lynden G., Winslow M. 2011. Experiences in Monitoring and Assessment of Sustainable Land Management. *Land Degradation & Development* 22 (2), 214-225. Doi 10.1002/ldr.1040
- Shrestha, S., & Bhandari, P. (2007). Environmental security and labor migration in Nepal. [10.1007/s11111-007-0059-0]. *Population and Environment*, 29(1), 25-38.
- Sudmeier-Rieux, K., Gaillard, J.C., Sharma, S., Dubois, J., Jaboyedoff, M. 2012. Chapter 7 Floods, Landslides, and Adapting to Climate Change in Nepal: What Role for Climate Change Models? In: Armando Lamadrid, Ilan Kelman (ed.) *Climate Change Modeling For Local Adaptation In The Hindu Kush-Himalayan Region (Community, Environment and Disaster Risk Management, Volume 11)* Emerald Group Publishing Limited, pp.119 - 140
- Sudmeier-Rieux, K., Jaquet, S., Derron, M.-H., Jaboyedoff, M., and Devkota, S. 2011. A Case Study of Landslides and Coping Strategies in Two Villages of Central-Eastern Nepal. *Journal of Applied Geography* 32, 680-690
- UNDP, 2012. Multi Hazard Risk Assessment Study and Development of Strategic Implementation Plan Phewa Watershed Area, Kaski.
- Valdivia, C., Seth, A., Gilles, J. L., Garcia, M., Jimenez, E., Cusicanqui, J., et al. (2010). Adapting to climate change in Andean ecosystems: Landscapes, capitals, and perceptions shaping rural livelihood strategies and linking knowledge systems. *Annals of the Association of American Geographers*, 100(4), 818-834.
- Warner K, Hamza M, Oliver-Smith A, Renaud F, Julca A. 2010. Climate change, environmental degradation and migration. *Nat. Hazards* 55:689-715
- WOCAT 2014. <https://www.wocat.net/en/about-wocat/vision-mission/sustainable-land-management.html> (accessed on 20.09.2014)
- Zoomers, A. (2012). Migration as a failure to adapt? How Andean People Cope with Environmental Restrictions and Climate Variability. *Global Environment, Special Issue on Environmental Change and Migration in History*(9), 104-129.