Chapter 11
Impacts of Outmigration on Land Management in a Nepali Mountain Area

Gudrun Schwilch, Anu Adhikari, Michel Jaboyedoff, Stéphanie Jaquet, Raoul Kaenzig, Hanspeter Liniger, Ivanna M. Penna, Karen Sudmeier-Rieux, and Bishnu Raj Upreti

1 Introduction

1.1 Study Objectives

Worldwide land users face the challenge of producing from land while minimizing natural resource degradation (Foley et al. 2011). Land management in mountains poses particular problems, constrained by steep slopes, inaccessibility, remoteness, and often harsh climatic and weather conditions. Working on sloping land hampers mechanization and therefore requires more manual labor; it also requires special care to manage run-off caused by heavy rains, and related soil erosion and mass movements. Mountain areas also depend on roads to access markets and centers, which are difficult to construct. There are, however, advantages, such as access to sufficient water, higher (although sometimes excessive) rainfall than in lowlands, and often very adapted, traditional, and rich sociocultural systems that have evolved over thousands of years. These systems are neither fixed nor isolated from

G. Schwilch (✉) • S. Jaquet • H. Liniger
Centre for Development and Environment CDE, University of Bern, Bern, Switzerland
e-mail: gudrun.schwilch@cde.unibe.ch

A. Adhikari
International Union for Conservation of Nature IUCN, Kathmandu, Nepal

M. Jaboyedoff • I.M. Penna • K. Sudmeier-Rieux
Group of Risk Analysis – Institute of Earth Sciences (ISTE), University of Lausanne, Lausanne, Switzerland

R. Kaenzig
Institute of Geography, University of Neuchâtel, Neuchâtel, Switzerland

B.R. Upreti
Nepal Center for Contemporary Research NCCR, Kathmandu, Nepal

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globalization, and outmigration 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 have been widely studied (Piguet 2013; Warner et al. 2010), there is a gap in the literature on how migration impacts land management, and how climate change and increasing disaster occurrence affect sustainable land management practices. While migration research is often focused on those who migrate or where they migrate to (Black et al. 2011; Findlay 2011; Piguet 2013), land management studies, on the other hand, tends to consider land user families as a complete and stable unit (de Graaff et al. 2008; Gisladottir and Stocking 2005; Hurni 2000). Additionally, earlier land management studies focused more on whether population growth increased or decreased land degradation (Carswell et al. 1998; Thapa and Weber 1995; Tiffen et al. 1994; Warren 2002), but not on the reverse phenomenon—population decline—which has been observed more recently. It is therefore crucial to examine in detail how land management is sustained under changing population and climatic conditions, as failing to care for land could promote natural hazards such as floods or landslides. Nonetheless, outmigration may also have positive impacts on the land. Remittances, for example, can improve living conditions or help finance new land management measures. This chapter focuses on the impacts—both positive and potentially negative—of outmigration on land management.

The aim of the study was to identify how land management in mountains is affected by migration. The main study site was in Nepal, in the Panchase area of the Western Development Region; a sister study site was also selected in Bolivia, in the Quillacollo District of Cochabamba. 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 fieldwork, with a main focus on results from the Nepali case study, as not all field assessments were also conducted at the Bolivian site. Nevertheless, the results from Bolivia are briefly presented in a box, as they still give important insights into differences and similarities across the two sites on two continents.

1.2 Conceptual Framework

The study is based on two complementary conceptual frameworks: the sustainable livelihoods framework and the sustainable land management (SLM) framework. The sustainable livelihoods framework (DFID 1999; Scoones 1999) defines livelihoods as access to five basic capitals or resources (social, human, economic, natural, and physical) and is considered as the standard approach to understanding livelihoods and vulnerability (Upreti and Muller-Boker 2010). The SLM

framework (Schwilch et al. 2011; UNU-INWEH 2011) is a holistic and integrated concept which provides an overview of the cause–effect interactions of land degradation and SLM on environment and human well-being. SLM is considered the "response" to the "drivers," "pressures," and "states" of degradation, and it enhances the provision of ecosystem services and thus improves human well-being and reduces poverty. The World Overview of Conservation Approaches and Technologies (WOCAT) network and program 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). SLM has the capacity to directly address all three UN environmental conventions. It helps to prevent desertification (UNCCD), increase biodiversity (UNCBD), and make people less vulnerable to the effects of climate change (UNFCCC). Although many of these positive effects of SLM are known, there is insufficient evaluation of how SLM is impacted by migration in a context of disasters and climate change.

The two frameworks are therefore 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 identified drivers of change. They can be in a causal relationship and create—alone or combined—more vulnerability and strains on livelihood strategies. These strategies then lead to a change in land management or increased outmigration. Adapted livelihood and land management strategies can in turn have an impact on resource access or environmental degradation and hazard events, especially in fragile environments such as mountains.

1.3 Natural Hazards and Climate Change Impacts

Natural hazards and climate change are adding a new dimension to land management in mountainous areas. Climate change models are uncertain at best, but data on monsoon rains point towards more intense rainfall patterns, longer drought periods, and new higher ranges for crops (Sudmeier-Rieux et al. 2012). Data analyzed 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 crops can grow at increasingly higher elevations. According to 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). The uncertain climate conditions, noticeable over the past 10 years, have created more uncertainty for managing land, especially as mountain farming communities are now heavily impacted by labor loss due to migration.

1.4 Migration Impacts

In Nepal, migration is a common strategy to improve livelihoods, especially among mountain people. Migrants are mostly men and they migrate to other Asian countries, most commonly India, followed by the Gulf countries (NIDS and NCCR 2011). In recent years the number of migrants has increased, for reasons related to rural poverty, environmental degradation, 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 (Andersen 2002; Seddon et al. 2002).

Migration-induced demographic changes and economic factors such as remittances influence the natural resource management of those left behind (Gartaula et al. 2012; Maharjan et al. 2012). Land abandonment, for example, is a growing consequence of outmigration (Khanal and Watanabe 2006; Paudel et al. 2012), but it is not yet clear what other impacts that migration may have on land management. It is this aspect upon which we aim to shed light. Migration leaves behind fragmented families (often a wife and children) and the elderly to deal with managing the land in addition to daily life challenges (Black et al. 2011; Grau and Aide 2007). Having less labor may be accompanied by a reduction in land management expertise on cropland, grazing, forest, and mixed land (e.g., maintenance of terraces and irrigation canals, or stabilization of slopes), and is further challenged by changing climate conditions and growing environmental threats (Gray 2009; Valdivia et al. 2010). On the other hand, remittances might help households invest in more sustainable agricultural practices in addition to supporting livelihoods through the purchase of food, goods, and better schooling (Davis and Lopez-Carr 2010; Nijenhuis 2010).

2 Methods

This study integrates biophysical and socioeconomic data through a case study and a mapping approach. From the social sciences, we drew upon well-tested qualitative methodologies typically used in vulnerability and capacity analyses, such as semi-structured interviews with key informants, focus group discussions, and transect walks. The biophysical analysis of the current environmental conditions determining hazards and structural vulnerability was obtained from remote sensing analysis, fieldwork studies, and GIS analysis. Some of the methods are outlined in more detail below.

In Nepal, the assessment of the consequences of migration on the area of origin was linked with a mapping and appraisal of land management practices (Schwilch et al. 2011). The WOCAT mapping tool makes it possible to capture major land degradation as well as land management practices and technologies, their spread, effectiveness, and impact within a selected area (Liniger et al. 2008). Data drawn from a variety of sources is compiled and harmonized by a team of experts

comprising land degradation and conservation specialists working in consultation with land users from various backgrounds. Knowledge provided by specialists and land users is combined with existing datasets and documents (maps, GIS layers, high-resolution satellite images) and jointly verified in workshops. 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 subwatershed in the Kaski district, an area of 36 km^2. A land use map of the Phewa catchment area, of which the Harpan watershed is part, served as a base map. It was produced by the local NGO (Machhapuchhre Development Organization) using *rapid eye* satellite images 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.

Finally, the mapping was used together with other socioeconomic data to combine information about migration types and land management issues. To obtain these data, a household survey was conducted in six communities within the watershed. Swiss and Nepali researchers jointly designed and tested the questionnaire based on previous knowledge and research conducted in Nepal (Sudmeier-Rieux 2011). The questions were centered on household demographics and socioeconomic status, housing and infrastructure, land use and land management, damage from disasters, the migration situation and remittances, and other institutional and social issues. Between 10 and 30 % of the households were thus surveyed using a systematic sampling method. The resulting data were complemented through interviews, focus group discussions, and expert consultation. GIS and descriptive statistical analysis, as well as a content analysis of the qualitative data, was used to understand, quantify, and visualize those links. As research and analysis is still underway, not all data collected was used in this chapter.

3 Study Area

The study area was selected considering the following criteria—an area with a high level of outmigration, proximity to an urban center, harsh environmental conditions, and land management issues. We obtained information about outmigration from national statistics. To identify harsh environmental conditions, we analyzed relief and geomorphology, referring to processes shaping the landscape, causing intense erosion or occurs at a rate that challenges the capacity of people to deal with their dynamics. Information about land management included available knowledge

about SLM practices from within the local partners and previous projects (e.g., NEPCAT,[1] EbA[2] projects from IUCN in Nepal).

The study area is located in the Panchase area, or more specifically, the Harpan river subwatershed in the Kaski District, Western Nepal, near the city of Pokhara. With a precipitation of 4,000 mm per year and altitudes ranging from 800 m to 2,517 m.a.s.l., the area is considered the water tower of the Phewa watershed and lake (GoN 2013). The climate is subtropical and soils are usually thick. Based on data from the Central Bureau of Statistics (GoN 2012), the estimated number of households in the subwatershed is 894, with 3,330 persons in total and 93 persons/km^2. Major nonclimate pressures include overexploitation or unsustainable use of resources, overgrazing, and pest infestation, while climate-induced pressures include habitat destruction, biodiversity loss, an increase in invasive alien plant species, and a degradation of ecosystem functioning (EbA 2014). The Panchase region is one of the most heavily affected by landslides in Nepal and has high outmigration, creating a severe and underreported impact on food security and sustainable local development (Sudmeier-Rieux 2011).

4 Results

4.1 Migration: People's Concerns and Use of Remittances

Of the 58 households surveyed, 81 % have at least one member, mostly men and young people, living somewhere else in Nepal or abroad. However, due to cultural and legal barriers, only few women migrate abroad, and those who can afford it prefer to move to main Nepali cities (Ghimire and Upreti 2012). People interviewed in the different areas prioritized their main concerns according to a list of proposed choices. The top priority was unemployment, which appears logical given the significant outmigration rates in those villages (see Fig. 11.1). Health and sanitation, road access, and education also featured prominently. Landslides and flooding are only deemed minor problems, mainly mentioned by families most affected by these in Harpan and Ghatichhina. Of lower concern were agricultural and farming issues as well as access to land and water.

This may not be surprising considering that agriculture has become a smaller part of household income: 78 % of respondents said off-farm income comprised more than half their earnings. Many households depend mainly on remittances, whether in the form of financial or material support. Remittances are used primarily for food (63 % of responses) and to an extent on education (9 % of responses). The

[1] Nepal Conservation Approaches and Technologies, http://www.icimod.org/nepcat

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

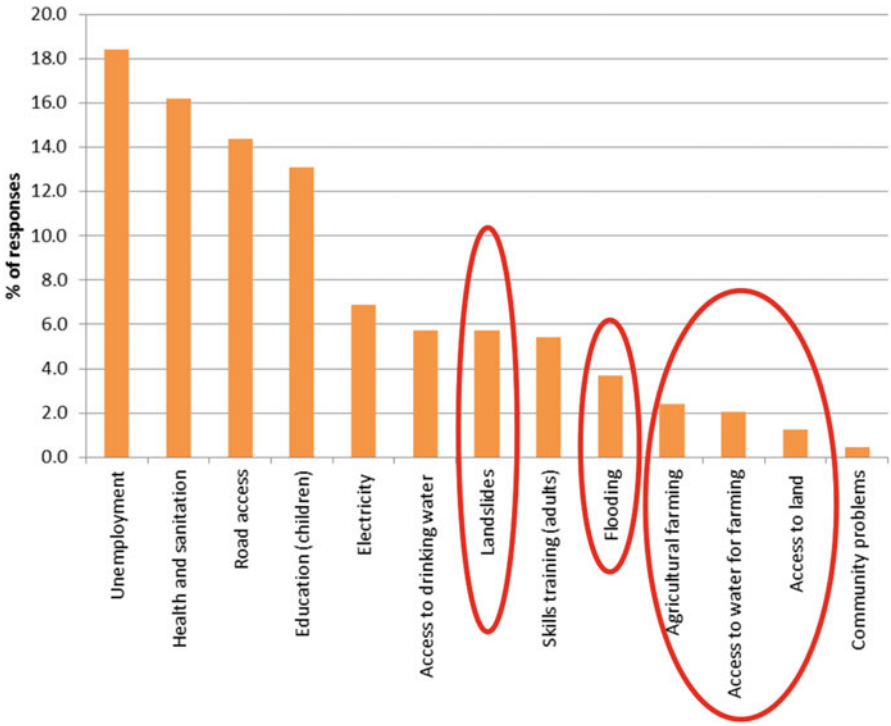

Fig. 11.1 Main concerns mentioned by 58 household respondents in Panchase, Nepal (the five main concerns were weighted by their rank). *Red circles* highlight environmental concerns

analysis revealed that remittances are hardly used for agricultural purposes (2 % of responses).

4.2 Land Degradation and Land Abandonment

Forest covers more than 70 % of the watershed, mainly in its upper western and southern reaches. Since 1996 forest cover has shown a net increase of over 12 %, due to the abandonment of cropland (Jaquet et al. 2015). 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. (2015), almost 22 % of the cropland area is currently abandoned.

The WOCAT mapping revealed that only 1.3 % of the area and 2.8 % of the cropland is affected by soil erosion (loss of topsoil and gullying), with the trend decreasing slightly on average. Favorable ecosystem recovery conditions mean that abandoned terraces are rapidly covered by grasses, bushes, and trees. A woman from Upper Makawanpur says: "*Abandoned land is stronger now through trees, not*

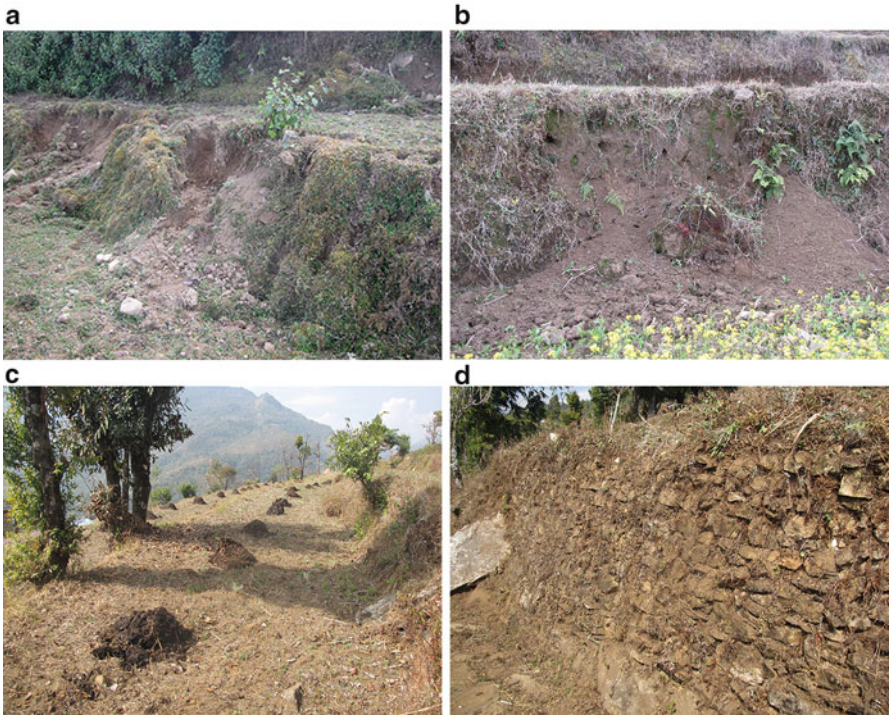

Fig. 11.2 Terraces are usually well maintained. Damages on terraces, whether abandoned or not, are rare. (**a**) animal trampling on abandoned terraces, (**b**) mice holes in terrace riser, (**c**) application of manure, (**d**) terrace riser reinforced with stones (Photos: G. Schwilch)

fragile anymore." Even when grazed, there were very few signs of damage on the terrace risers such as those shown in Fig. 11.2. The damages seen in Fig. 11.2a, b represent rare exceptions and most interview partners confirmed this impression from the field survey. With fewer animals in the villages, there was also less deterioration from grazing on abandoned terraces. The terraces still in use for agriculture are usually well maintained, i.e., manure is applied (Fig. 11.2c) and, where necessary, terrace risers are enforced by stone walls (Fig. 11.2d).

It is often assumed that less land management and abandoning terraces would lead to more soil erosion (see, e.g., Gerrard and Gardner 2002; Harden 1996; Khanal and Watanabe 2006). However, the results of this study show the contrary or at least a more differentiated picture. The field survey and mapping, interviews, and focus group discussions revealed no increased soil erosion problems from agricultural or forest land.

Road construction, however, did cause increased erosion and shallow landslides. Within the Harpan subwatershed, damage from road construction (e.g., soil deposits on the land just below the new road) 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 construction. A majority of rural earthen roads are funded partly by local government authorities (Village Development Committees) and partly 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 results from the WOCAT mapping show that the main type of degradation in the area is biological. More specifically, this has been caused by the increased spread of invasive alien plant species, which have affected 39.2 % of the studied area. The two main species are Nilo Gandhe (*Ageratum Houstonianum*) and Banmara (*Ageratina adenophora*), plants which appeared only 5 years and 10 years ago respectively. Nilo Gandhe is toxic for animals and both are difficult to remove. People participating in the mapping clearly linked this degradation type to outmigration and land abandonment, as illustrated by these two statements: "*If there were 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; we lack the labor to clear it better*" (woman in Upper Makawanpur). The problem is that Banmara can spread vegetatively and could worsen if care is not taken when weeding or plant pieces are dropped randomly. Thus, with land abandonment and less labor available for weeding, both species spread increasingly (see also Jaquet et al. 2015).

Fertility decline and reduced organic matter content is a problem on 8.4 % of the area, and in particular, within 32.1 % of the cropland. Those participating in the mapping, as well as the interview partners, attributed this to outmigration, as this has reduced the number of animals and thus the availability of manure, along with 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 Sidane), referring to the labor shortage-induced reduction from two crops a year to one. 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*), increases fertility as fewer nutrients are extracted from the soil. However, this might not be significant and would need to be further investigated. Around Ghatichhina, the village to which some upstream households migrate, cropland suffers from declining fertility as the growing population increases production from two to three crops per year. There is no land degradation on just over half (50.6 %) of the total area. 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 (see Fig. 11.3a), pressure on natural resources is higher in the lower, more densely populated sectors of the watershed in the west as well as in most cropland units. Upstream areas and the eastern part of the catchment are much less affected. As mentioned above, it is mainly the forest units that show very little degradation, with less than 10 % affected. A similar picture emerges when showing the extent of SLM measures

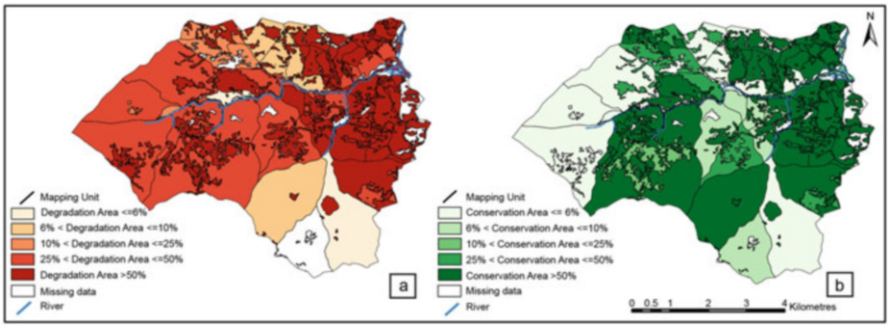

Fig. 11.3 Comparison of the total extent of degradation (**a**) and of SLM measures (**b**) per map unit, showing that areas with a high extent of degradation often also have a high extent of SLM measures

applied (Fig. 11.3b). The map units with a high extent of degradation often also have a high extent of SLM measures. Based on the interviews, this can be explained by the higher population density in downstream areas, reinforced by outmigration from upstream or remote locations to these lower sectors of the watershed. This supports the hypothesis that abandoned land resulting from outmigration does not increase land degradation problems (see also discussion and conclusions).

4.3 The Social Impacts of Outmigration and Land Abandonment

More than half (54.3 %) of the households interviewed have abandoned land, with the main reason mentioned for this as a lack of labor availability (Jaquet et al. 2015). Lack of labor means that some of the cropland can no longer be cultivated, but gender issues also play a role. Asked about problems when women manage the land, a representative from Lower Makawanpur responds: "*Yes, it is a big problem for the women to plough. Some of the abandoned land is from these women. It is abandoned because they cannot cultivate it*." The women left behind are overburdened with additional male work, such as plowing or roofing, which they are traditionally not allowed to do. Although women face problems cultivating land because one or more of their male family members have migrated, women are also empowered in terms of overall land management, as they are forced to make decisions and deal with different actors such as the Village Development Committee (VDC) and government officials. Many of the inhabitants see no positive side to land abandonment. They regret that the land is no longer cultivated and complain that "*wild animals hide there*." Social life in the villages also suffers, with several villagers expressed really feeling like left-behinds. As a woman from Lower Sidane put it: "*If they have money, they migrate—we don't have money, so we are here*."

4.4 Sustainable Land Management (SLM)

Forest management (afforestation, forest protection) is applied to 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 steered by community forest user groups with specific rules about use and management. Additionally, there is the Panchase Protected Forest, which has been a protected area since 2011 (Panchase Protected Forest Program, Ministry of Forest and Soil Conservation). According to several interview partners, forest protection is effective in reducing landslide problems in the forest, and thus also reducing damage to the adjacent cropland. Overall, forest cover has increased by 12 % between 1996 and 2012 (Jaquet et al. 2015), during which time pressure on forest resources has decreased. According to a woman from Upper Sidane, this illustrates the link with outmigration and land abandonment: "*With abandoned land, we have access to fodder and don't need to go to the forest. Also with better stoves we use less firewood from the forest*." However, conserving the forest resource appears to have some disadvantages for the remaining population and their cropland, with several people reporting 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, people often omit to mention terraces, just because they are so normal in Nepal. However, they are a highly effective measure against land degradation, especially soil erosion. Besides maintaining traditional terracing, only few new SLM practices, such as vegetable farming, mulching, and agroforestry, are emerging. Overall, 53 % of the land in the Harpan subwatershed has some kind of SLM practice (49.3 % of forest, 59.7 % of cropland). In addition to forest management and terracing, these include nutrient management, protection against natural hazards (such as gabion walls with vegetative measures, 1 %), and grazing land management (0.6 %) (Jaquet et al. 2015).

Box 1. Summary of results from the sister study conducted in Bolivia

The second study site for part of the same research is the Jatún Mayu-Pankuruma watershed from Sipe Sipe municipality in the Quillacollo district (Cochabamba Department), central Bolivia. This is one of the poorest areas in the Cochabamba Department, with high outmigration rates and harsh environmental conditions. The area suffers from severe land degradation, mainly due to landslides, fluvial erosion, wind erosion, and gully formation, which leads to a loss of land and productivity. Furthermore, it is becoming increasingly difficult to predict extreme climatic events such as occurrences of frost and hail. In Bolivia, mountain communities are highly mobile—a traditional

(continued)

and well-established way in Andean livelihoods to reduce vulnerability to both environmental and nonenvironmental risks (Kaenzig and Piguet 2014). Consequently, most households are involved in some type of migration; either long term (abroad), temporary (to another department), commuting and multiresidency (to neighboring cities), or return migration. Despite this high degree of mobility, migrants do not become disconnected with their community of origin. Instead, they usually stay in close touch with their mountain villages and return on a regular basis, either to maintain their plots of land or to fulfill their share of the responsibilities and roles that are divided among the community members. However, migration is causing schools to close or become centralized, traditional and rural knowledge is lost, and conflicts over land tenure emerge. In turn, these impacts themselves become drivers and push factors of migration.

Figure 11.4 shows that environmental hazards in Bolivia are high on people's list of major concerns, the most important being landslides and weather-related farming difficulties (e.g., crops threatened by hail and frost). Health and sanitation, unemployment, electricity, and education are also important concerns in this area. Of the five communities in the watershed, only one primary school is still operational, and in order to access 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 leave the mountains.

SLM measures practiced in the area are terraces, gabion walls, and grass strips. The impacts of migration on land management practices are not yet

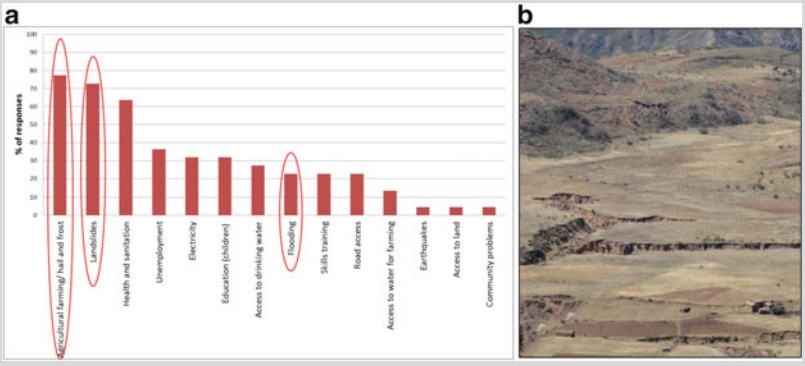

Fig. 11.4 (**a**) Main concerns mentioned by 22 household respondents in three communities from the Jatún Mayu-Pankuruma watershed, Quillacollo district, Bolivia. *Red circles* highlight environmental concerns. (**b**) Agricultural land with gully erosion (Photo: I. Penna)

(continued)

fully clear, but some important aspects are emerging from the information obtained during the interviews. Double-residence migrants still use their land, coming back on some days to work on it. However, multiresidency leads to a tendency to reduce land management work or to change the way land is used. Less able to exploit land due to labor force shortages, people farm mainly on the most accessible and/or productive parcels. Whether land is being completely abandoned is unclear, as people are reluctant to speak about land tenure with outsiders like researchers. Inhabitants have only obtained the right to own their land and crops since an agrarian reform in 1952 and land property has remained a very sensitive issue amid people's fears of losing their rights again.

Contrary to our initial hypothesis, we observed that there was no substantial process of feminization in the study area in Bolivia. Instead, entire families are migrating. Most families migrate to the valley of Cochabamba or within Bolivia, and the men (sometimes with their wives) return to the mountain to maintain fields or participate in community meetings. Remittances are not common and most of the time family members return with food or consumer items. The main phenomenon observed in Bolivia relates to an aging population. Migration leads to a loss of traditional farming knowledge, but it also leads to changes in the traditional plantation calendar, which is itself threatened by increasingly uncertain climate predictions. Our analysis shows that younger farmers have less knowledge about natural weather indicators and corresponding agricultural measures, leading to a loss in agricultural production. Additionally, the decrease in labor force is leading to a lack of maintenance of agricultural lands and increased problems with land management, possibly leading to degradation. However, some important questions remain: what causes such intense gullying? Is grazing a major cause of degradation? Do people abandon their land at all and if so, what impact does this have on the land? In Bolivia, it is difficult to distinguish fallow land from abandoned land, as land abandonment is a sensitive issue.

5 Discussion

This study has assessed land use, land degradation, SLM practices, migration patterns, use of remittances, and concerns of the people left behind, to achieve a better understanding of how migration affects land management in mountainous areas. By bringing together these two issues—land management and migration—it goes further than previous studies, which have focused either on migrants' livelihoods or evaluated land management without taking into account migration-induced changes in family patterns.

Our study sheds light on the strong link between migration and land management in the Panchase area of Nepal. Even within a rather small watershed like the

Harpan river subwatershed, there are areas of outmigration as well as in-migration. While 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 **outmigration**, which are all in a cause–impact relationship:

1. ***Less human population*** results in less livestock in villages. This means that less manure is produced to fertilize the soils.
2. The population decrease-induced ***labor shortage*** has several impacts. First, reducing production to only one crop per year leads to reduced income (as more food has to be bought). Second, cropland terraces are no longer cultivated 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 fully grown woodland. Fodder thus no longer needs to be sought from the forest.
4. ***Less land degradation*** due to less intensive use of resources. An important exception here is that there is a massive increase in invasive alien plant species. Soil erosion thus generally decreases, while vegetation cover increases.
5. ***Expansion of forest***, with a likely increase in biodiversity and wildlife (again, partly threatening cropland).

We found hardly any literature differing from or confirming these causal consequences, which we believe verifies our statement that the impacts of outmigration on land management in the area of origin are not well researched. Our results do not confirm those of earlier studies in mountainous areas that reveal increased landsliding, soil erosion, and a higher susceptibility to slope failures on less-managed cultivation terraces and on grassland (abandoned terraces) (Gerrard and Gardner 2002; Harden 1996), although long-term monitoring might change the picture (Khanal and Watanabe 2006).

However, our study did confirm the finding of Paudel et al. (2012) that the labor shortage resulting from outmigration is the major constraint to agricultural activities, leading to changes in the cropping patterns. Labor shortages are causing farmers either to shift towards a single crop per year or even to abandon their land in favor of wage labor, providing them with less-risky and more immediate benefits. The observation of Davis and Lopez-Carr (2014) that remittances are either invested to expand agricultural land, intensify its management (e.g., through chemical fertilizer and pesticides), or shift to more cattle-based systems, however, was not confirmed in our study, where remittances are hardly invested in agriculture at all.

As there are also areas of **in-migration** in the Harpan subwatershed, especially the downstream village of Ghatichhina and surroundings, we were also able to identify and consider these impacts:

1. ***More population*** leads to more pressure on land resources in in-migration villages.

2. More people on ***less land*** requires the cultivation of an additional crop, i.e., an increase from two to three crops per year.
3. ***Increasing the intensity of land use*** leads to decreasing soil fertility and to potentially less careful land management, such as cultivating crops that require less postharvest processing (e.g., potatoes). Potatoes potentially increase soil erosion due to the heavy soil disturbance during harvest.

These impacts of in-migration on the lowland area confirm the findings of Gautam et al. (2003), where the authors reported an increased fragmentation of lowland agricultural areas due to urbanization and increased crop diversification in the remaining lowlands.

Comparing these results from Nepal with the sister study done in Bolivia (see Box 1) reveals two very different contexts, although in both cases migration is spurred by unemployment and lack of educational opportunities. In Nepal, migrants (mainly male) leave behind fragmented families and the elderly to manage the land, and those left behind rarely use remittances to invest in agriculture. In Bolivia, people move dynamically between urban areas and their communities of origin in the mountains, returning home at intervals to work on their lands. In a major difference between the two contexts, environmental threats are of greatest concern in Bolivia, while in Nepal these figured only in seventh place and below. In both locations, climate change is increasing the frequency and magnitude of extreme weather events, shifting crops (and invasive species) upslope and rendering 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 in the face of changing demographics, uncertain climatic conditions, less labor available, and lower food production in mountain areas. There is an obvious shift from local food production to a greater reliance on remittance income and imported foods.

Lessons drawn from this research are that multiple pathways of outmigration, land abandonment, ecological impacts, and corresponding livelihood opportunities exist and thus need to be carefully investigated for each situation (Munroe et al. 2013). Evaluating these pathways can provide evidence to develop adapted land management and livelihood strategies.

6 Conclusions

The findings of this study suggest that a more differentiated, context-specific view is required when looking at the impact of migration on land management. There was no evidence to prove the often assumed negative impact of outmigration on land degradation. On the contrary, some types of degradation such as soil erosion or landslides were even reduced, and overall vegetation and forest cover had increased. But other types of land degradation have emerged, such as the increase in invasive alien plant species coverage, making farming more difficult for those

left behind. The main negative effect is sociocultural, as people's livelihoods are not only affected by the environmental state of the land they live on, but much more by the absence of their family members and neighbors. This threatens the social fabric and leads to a loss of traditional knowledge and cultural customs. A feminization of agriculture has been observed in the Nepali case study, while in the Bolivian case study, whole families generally migrate together and it is mostly the men who temporarily return to manage the land.

Even within small rural areas, topographic location and specific migration patterns determine how land is used and managed, and the consequences on land and livelihoods thus vary considerably from place to place. It is this interaction of livelihoods and land, which characterizes the high dynamism of these mountain areas and, when evaluated carefully and within its migration context, offers opportunities for sustainable development of both the environment and people's well-being.

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References

Adhikari B, Di Falco S, Lovett JC (2004) Household characteristics and forest dependency: evidence from common property forest management in Nepal. Ecol Econ 48(2):245–257. doi:10.1016/j.ecolecon.2003.08.008

Andersen LE (2002) Rural-Urban migration in Bolivia: advantages and disadvantages. Documento de Trabajo, 5

Black R, Bennett SRG, Thomas SM, Beddington JR (2011) Climate change: migration as adaptation. Nature 478(7370):447–449

Carswell GM, Lindblade KA, Tumuhairwe JK (1998) Mitigating the relationship between population growth and land degradation: land-use change and farm management in Southwestern Uganda. AMBIO 27(7):565–571

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. Popul Environ 32(2-3):216–237. doi:10.1007/s11111-010-0128-7

Davis J, Lopez-Carr D (2014) Migration, remittances and smallholder decision-making: implications for land use and livelihood change in Central America. Land Use Policy 36:319–329. doi:10.1016/j.landusepol.2013.09.001

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. Appl Geogr 28(4):271–280. doi:10.1016/j.apgeog.2008.05.001

DFID (1999) Sustainable livelihoods guidance sheet. UK Department for International Development, London

EbA (2014) Ecosystem and ecosystem services of panchase: an overview. EbA, Kathmandu

Findlay AM (2011) Migrant destinations in an era of environmental change. Global Environ Change 21(Suppl 1):S50–S58. doi:10.1016/j.gloenvcha.2011.09.004

Foley JA, Ramankutty N, Brauman KA, Cassidy ES, Gerber JS, Johnston M, Mueller ND, O'Connell C, Ray DK, West PC, Balzer C, Bennett EM, Carpenter SR, Hill J, Monfreda C, Polasky S, Rockstrom J, Sheehan J, Siebert S, Tilman D, Zaks DPM (2011) Solutions for a cultivated planet. Nature 478(7369):337–342, http://www.nature.com/nature/journal/v478/n7369/abs/nature10452.html#supplementary-information

Gartaula HN, Visser L, Niehof A (2012) Shifting perceptions of food security and land in the context of labour out-migration in rural Nepal. Food Secur 4(2):181–194. doi:10.1007/s12571-012-0190-3

Gautam AP, Webb EL, Shivakoti GP, Zoebisch MA (2003) Land use dynamics and landscape change pattern in a mountain watershed in Nepal. Agr Ecosyst Environ 99(1–3):83–96. doi:10.1016/S0167-8809(03)00148-8

Gerrard J, Gardner R (2002) Relationships between landsliding and land use in the Likhu Khola Drainage Basin, Middle Hills, Nepal. Mt Res Dev 22(1):48–55. doi:10.1659/0276-4741(2002)022[0048:rblalu]2.0.co;2

Ghimire A, Upreti BR (2012) Migration, mobility and development: enhancing our understanding in Nepal, SAs RCO Discussion Paper 6. South Asia Regional Coordination Office of National Centre of Competence in Research North-South and Nepal Centre for Contemporary Research, Kathmandu

Gisladottir G, Stocking M (2005) Land degradation control and its global environmental benefits. Land Degrad Dev 16(2):99–112. doi:10.1002/ldr.687

GoN (2012) National population and housing census 2011. GoN, Kathmandu

GoN (2013) District and VDC profile of Nepal. GoN, Kathmandu

Grau HR, Aide TM (2007) Are Rural–Urban migration and sustainable development compatible in mountain systems? Mt Res Dev 27(2):119–123. doi:10.1659/mrd.0906

Gray CL (2009) Environment, land, and rural out-migration in the Southern Ecuadorian Andes. World Dev 37(2):457–468

Harden CP (1996) Interrelationships between land abandonment and land degradation: a case from the Ecuadorian Andes. Mt Res Dev 16(3):274–280. doi:10.2307/3673950

Hurni H (2000) Assessing sustainable land management (SLM). Agr Ecosyst Environ 81(2):83–92. doi:10.1016/S0167-8809(00)00182-1

Jaquet S, Schwilch G, Hartung-Hofmann F, Adhikari A, Sudmeier-Rieux K, Shrestha G, Liniger HP, Kohler T (2015) Does outmigration lead to land degradation? Labour shortage and land management in a western Nepal watershed. Appl Geogr 62:157–170. doi:10.1016/j.apgeog.2015.04.013

Kaenzig R, Piguet E (2014) Migration and climate change in Latin America and the Caribbean. In: Piguet E, Laczko F (eds) People on the move in a changing climate, vol 2, Global migration issues. Springer, Dordrecht, pp 155–176. doi:10.1007/978-94-007-6985-4_7

Khanal R, Watanabe T (2006) Abandonment of agricultural land and its consequences. Mt Res Dev 26(1):32–40

Kollmair M, Banerjee S (2011) Drivers of migration in mountainous regions of the developing world: a review. In: Project F (ed) Migration and global environmental change. UK Government, London

Liniger HP, Van Lynden G, Nachtergaele F, Schwilch G (2008) Questionnaire for mapping land degradation and sustainable land management (QM), WOCAT, LADA, DESIRE. CDE Bern, FAO Rome, ISRIC Wageningen

Maharjan A, Bauer S, Knerr B (2012) International migration. Evidence from Nepal. International Migration, Remittances and Subsistence Farming, Kathmandu

Munroe DK, van Berkel DB, Verburg PH, Olson JL (2013) Alternative trajectories of land abandonment: causes, consequences and research challenges. Curr Opin Environ Sustain 5(5):471–476. doi:10.1016/j.cosust.2013.06.010

NIDS, NCCR (2011) Nepal Migration Year Book 2010. Nepal Institute of Development Studies (NIDS), National Centre of Competence in Research (NCCR) North-South South Asia Coordination Office, Kathmandu

Nijenhuis G (2010) Embedding international migration: the response of Bolivian local governments and NGOs to international migration. Environ Urban 22(1):67–79. doi:10.1177/0956247809356182

Oven KJ, Petley DN, Rigg JD, Dunn CE, Rosser NJ (2008) Landslides, livelihoods and risk: vulnerability and decision-making in Central Nepal. Paper presented at the First World Landslide Forum, Tokyo, Japan

OXFAM (2009) Bolivia: climate change, poverty and adaptation. OXFAM International, Bolivia

Paudel KP, Dahal D, Shah R (2012) Study report on abandoned agriculture land in mid-hills of Nepal, Status, causes and consequences. Australian Centre for International Agriculture Research, World Agroforestry Centre, Forest Action, IUCN, Nepal

Petley DN (2010) On the impact of climate change and population growth on the occurrence of fatal landslides in South, East and SE Asia. Q J Eng Geol Hydrogeol 43(4):487–496. doi:10.1144/1470-9236/09-001

Piguet E (2013) From "Primitive Migration" to "Climate Refugees": the curious fate of the natural environment in migration studies. Ann Assoc Am Geogr 103(1):148–162. doi:10.1080/00045608.2012.696233

Raya RB, Sharma S (2008) Impact of land use in water quality of Phewa Lake, Pokhara, Nepal. Paper presented at the World Lake Conference

Schwilch G, Bestelmeyer B, Bunning S, Critchley W, Herrick J, Kellner K, Liniger HP, Nachtergaele F, Ritsema CJ, Schuster B, Tabo R, van Lynden G, Winslow M (2011) Experiences in monitoring and assessment of sustainable land management. Land Degrad Dev 22 (2):214–225

Scoones I (1999) New ecology and the social sciences: what prospects for a fruitful engagement? Annu Rev Anthropol 28:479–507

Seddon D, Adhikari J, Gurung G (2002) Foreign labor migration and the remittance economy of Nepal. Critical Asian Stud 34(1):19–40. doi:10.1080/146727102760166581

Sudmeier-Rieux K (2011) On landslide risk, resilience and vulnerability of mountain communities in Central-Eastern Nepal. UNIL, Lausanne

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: Climate change modeling for local adaptation in the Hindu Kush-Himalayan region. Emerald Group Publishing, Bingley, pp 119–140. doi:10.1108/S2040-7262(2012)0000011013

Thapa G, Weber K (1995) Status and management of watersheds in the Upper Pokhara Valley, Nepal. Environ Manag 19(4):497–513. doi:10.1007/bf02471963

Tiffen M, Mortimore M, Gichuki F (1994) More people less erosion: environmental recovery in Kenya. John Wiley, London

UNDP (2012) Multi Hazard Risk Assessment Study and Development of Strategic Implementation Plan Phewa Watershed Area, Kaski

UNU-INWEH (2011) Guidelines for the Preparation and Reporting on Globally-relevant SLM Impact Indicators for Project-level Monitoring. United Nations University, Hamilton, ON

Upreti BN, Muller-Boker U (2010) Livelihood Insecurity and Social Conflict in Nepal. South Asia Regional Coordination Office, Swiss National Centre of Competence in Research (NCCR) North-South., Kathmandu

Valdivia C, Seth A, Gilles JL, Garcia M, Jimenez E, Cusicanqui J, Navia F, Yucra E (2010) Adapting to climate change in Andean ecosystems: Landscapes, capitals, and perceptions shaping rural livelihood strategies and linking knowledge systems. Ann Assoc Am Geogr 100:818–834

Warner K, Hamza M, Oliver-Smith A, Renaud F, Julca A (2010) Climate change, environmental degradation and migration. Nat Hazards 55(3):689–715. doi:10.1007/s11069-009-9419-7

Warren A (2002) Land degradation is contextual. Land Degrad Dev 13(6):449–459. doi:10.1002/ldr.532

WOCAT (2014) Sustainable land management. https://www.wocat.net/en/about-wocat/vision-mission/sustainable-land-management.html. Accessed September 20, 2014