

Land Use and Land Cover Changes in the Context of Agricultural Abandonment A Case Study in the Kaski District Area, Pokhara, Nepal

Problem statement and Objectives

Agricultural abandonment is a prevalent phenomenon in many rural areas worldwide, especially in mountainous regions, including developed and developing countries. The rural hill areas of Nepal present a particularly vivid example. As elsewhere, it is linked to out-migration processes, since labour migration is a core livelihood strategy of many households suffering from low incomes and lack of employment opportunities. The people, who stay behind, - mostly woman, children, and the elderly, are not able to maintain the entire cultivated area. This leads to land abandonment, especially relating to terraced land. Several authors reported that poorly managed abandoned terraces feature a high vulnerability towards geomorphic damage, e.g. soil erosion or landslides (Khanal and Watanabe 2006; Thapa and Paudel 2002; Thapa 1995) and therefore pose a high risk for continuing land degradation (Gerrard and Gardner 2002).

This research focuses on the abandonment of cultivated terraces in the Harpan sub-watershed (36km²), which is located in the NW of Pokhara in the middle hills of Nepal. The main goal was to map the present extent of abandoned terraced land in 2014. Further, it was the aim to identify changes in forested and cultivated surface area, which have occurred within a time span of 36 years (1978-2014) due to continuous out-migration within the watershed. It was analysed if the abandonment of cultivated terraces leads to physical degradation such as landslides and how it affects the application of local land management practices. This research is embedded in the PhD of Stephanie Jaquet, who is focusing on the impact of out-migration on land degradation and land abandonment in the mountain areas of Nepal (a project funded by Swiss Network for international Studies (SNIS)). Within the scope of her PhD this study contributes to a better understanding of land use and land cover changes (LULCC) in the middle hills of Nepal. The LULCC analysis as well as the detailed land use and land cover (LULC) map of the study area offer essential information for the development of local action plans on sustainable watershed management.

Conceptual Framework and Methodology

The methods applied in this case study are mainly based on the DPSIR framework, which describes a causal chain from human and natural driving forces (out-migration), pressures (abandonment of cultivated terraces), states (changing land use and land cover patterns), impacts on ecosystems (e.g. increasing vulnerability towards natural hazards), and local (household) responses (land management practices).

The land use and land cover (LULC) patterns of the Harpan sub-watershed present in 2014 were manually mapped during an in-depth field survey according to the LULC information of two high-resolution satellite images from 2012. Aerial photographs from 1978 were used for the automatic classification of the LULC patterns in 1978. The changes in forested and terraced surface area between 1978 and 2014 were then identified by overlay analysis in ArcGIS. Six villages were chosen for deeper analysis in order to understand LULCC dynamics on village scale. For them, maps were produced in higher detail and terraces were distinguished between rainfed *Bari* and irrigated *Khet* terraces. Additional qualitative information on the village situation regarding the out-migration rate, the application of land management practices, and the state of degradation was obtained from the local farmers.

Results and Discussion

The land use and land cover (LULC) mapping and the land use and land cover change (LULCC) analysis confirm a strong impact of out-migration processes on LULCC dynamics in the Harpan sub-watershed. The total terraced surface area had decreased by 36% and the total forest cover had increased by almost 13% within a time period of 36 years. Twenty-five percent of the total terraced area mapped in 2014 was abandoned (see Annex: figure 1).

However, the LULCC analysis indicates opposing trends between the uphill areas and the valley area in the watershed. Upland agriculture is decreasing significantly while lowland agriculture increases (see Annex: figure 2), a situation that was also observed in other hillsides of Nepal and in other mountainous areas of the world.

The study area is thus characterized by a decrease in cultivated terraced surface area combined with an increase in forest cover in the uphill areas due to the out-migration of local population. The remittances, which are sent back from the out-migrants, lower the necessity for cultivation, as they ensure the financial livelihood of the remaining household members. As most terraces that are taken out of use convert into shrub land and later on into forest, abandonment processes in the remote uphill areas have a positive impact on the slope stability rather than a negative one. In addition, the newly formed forest serves as essential resource in form of fodder, timber, and firewood. Results of previous studies, which stated increasing physical degradation such as soil erosion and landslides due to the abandonment of cultivated terraces, could thus not be supported by our research. Only a few landslides were identified in the study area and these occurred mostly due to poorly managed road constructions along steep slopes.

In the valley area an increase of cultivated terraces was observed, which is related to watershed-internal migration processes. These occur when people from the remote villages move down into the valley in order to gain better access to the market and to infrastructural facilities. The population growth leads to a substantial land use intensification, which increases the pressure on local resources such as soil and forest. The LULCC analysis shows that the agricultural area and the settlements in the valley are expanding on flood prone areas of the local rivers (see Annex: figure 3). The building development in the valley area within the last 36 years has increased the exposure towards natural hazards such as flooding, landslides, as well as riverbank and soil erosion. Thus, it endangers the livelihood of the local population increasingly. The latest flooding of the Harpan Khola, which occurred at the end of July 2015, confirms this statement (www.ekantipur.com). Strong monsoonal rainfall as well as a big landslide destroyed houses and roads and even caused death. Appropriate spatial planning policies with regard to disaster-risk reduction need to be formulated in order to ensure the livelihood of the present population as well as of the future generation.

The decrease in upland agriculture and the increase in lowland agriculture are also expressed in different and changing land management practices, which are applied within the watershed. In the remote uphill villages physically work intensive structural measures such as terracing are increasingly replaced by vegetative and management measures due to labour shortages and abandonment processes. For example, the cultivation of organic vegetables and coffee requires less physical work than the construction and maintenance of terraces. The situation in the valley area involves the application of different structural, agronomic, and vegetative measures in order to ensure the food security and to prevent land degradation.

Conclusion and Outlook

The findings of this case study indicate that the abandonment of cultivated terraces in the middle hills of Nepal might not be the major problem in the context of out-migration of local population. Instead, the increase of lowland agriculture due to watershed-internal migration processes is more problematic – it endangers local livelihoods! Without applied spatial planning and disaster risk management the settlements and the agricultural area are expanding in flood prone areas. The high pressure on the land increases degradation in form of decline in soil fertility, reduction in vegetation cover as well as riverbank and soil erosion.

Further research is necessary with focus on the current land use and land cover (LULC) development in lowland areas within the middle hills of Nepal. Appropriate policies need to be formulated, which provide spatial planning for those areas in order to ensure the livelihood of the local population in a sustainable way. Hazard zone maps including information about the potential threat posed by floods and landslides should be created for those specific areas in order to support land use planning decisions. In this regard, sustainable development requires additional research on the local land use and land cover dynamics as well as the creation of new jobs in all sectors, including industry, services, and agriculture.

Annex



Figure 1: Abandoned terraces in the uphill area of the Harpan sub-watershed (source: Fritzi Hartung-Hofmann 2014)

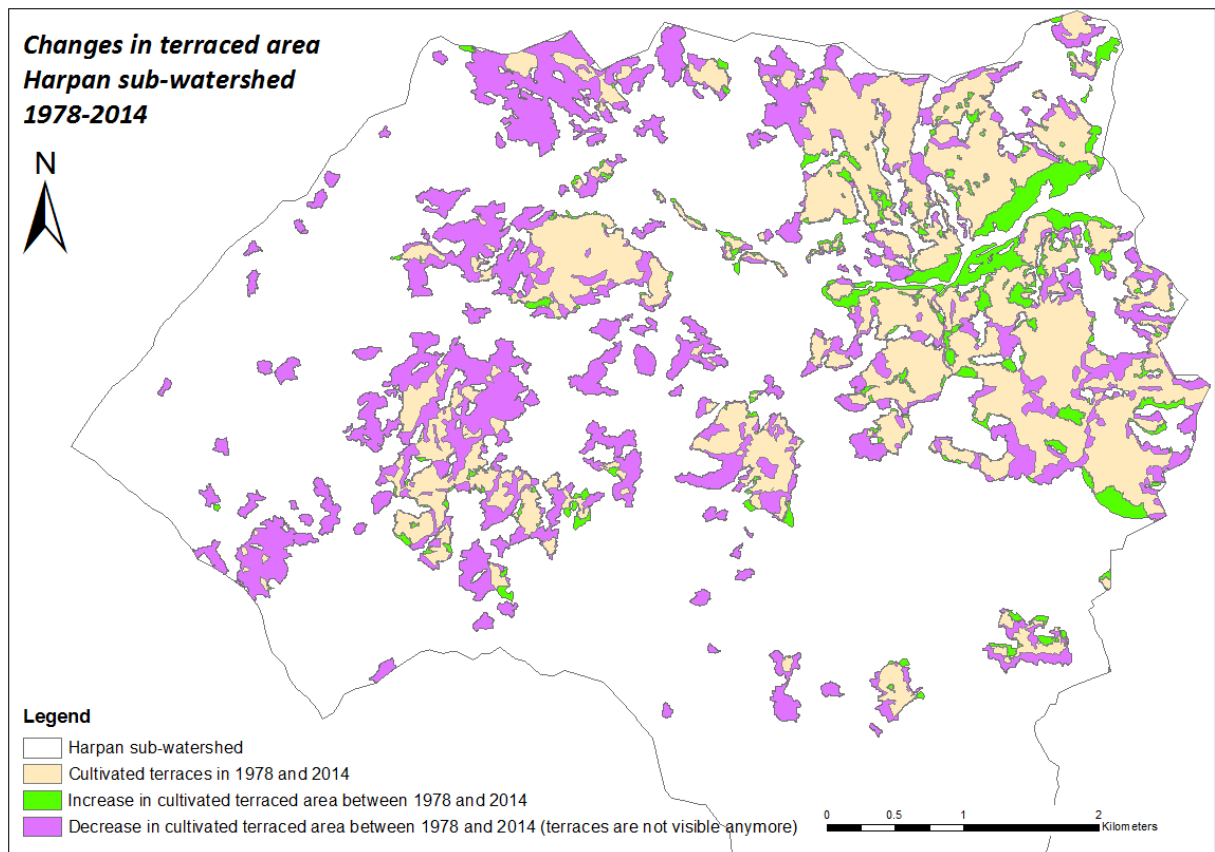


Figure 2: Changes in cultivated terraced surface area between 1978 and 2014, Harpan sub-watershed (source: Fritzi Hartung-Hofmann 2014)

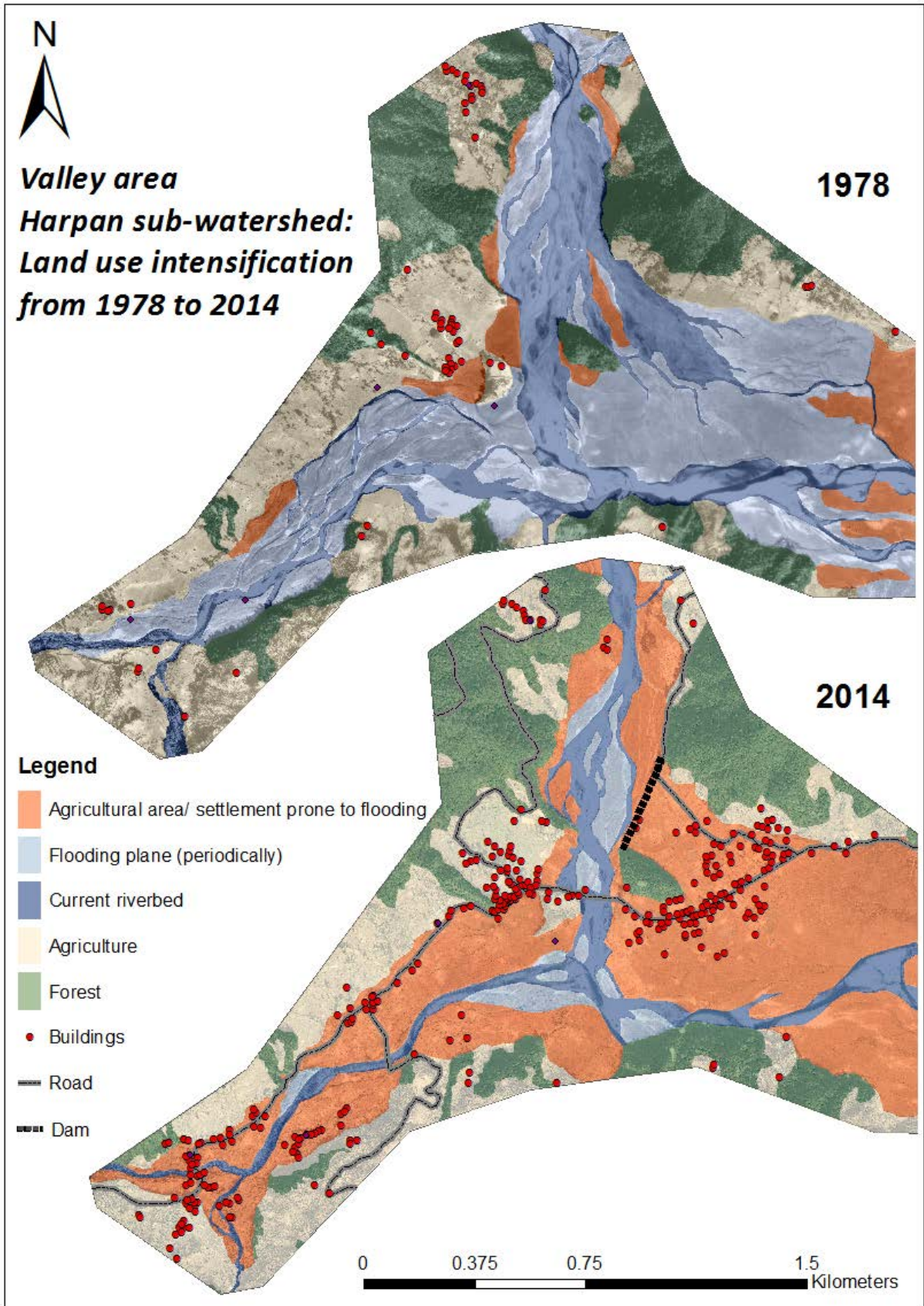


Figure 3: Land use intensification and spread of settlements between 1978 and 2014 in the eastern valley area of the Harpan sub-watershed (source: Fritzi Hartung-Hofmann 2014)