Climate and Land Use Change in Gandaki River Basin and its Impacts to Livestock Herding

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Research Brief

Feed the Future Innovation Lab for Collaborative Research on Adapting Livestock Systems to Climate Change

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Abstract

The scientific community generally agrees that climate change is occurring and will become worse. The temperature record in Nepal has an increasing trend but the precipitation does not have any significant trend. Livestock are an integral part of the mixed farming system and socio-economical life in Nepal. Climate resiliency could be increased by enhancing the livestock sectors, particularly among the smallholder farmers in Nepal. Around 87 percent of the country's total population keeps some form of livestock at home and the rate is higher in the high mountains and among poor people. The major problems in the livestock sectors in Nepal are malnutrition, disease and infertility. Vegetation is the main source of nutrition for livestock and its contribution is higher in the highlands as there is no access to supplementary feeding materials. There are multiple factors coupling together to change the vegetation cover: snow cover, population of livestock and humans, temperature and precipitation, plus socio-economic factors. This research identifies the change in those factors over time using historical observation data sets that include geo-spatial information and identifies the contribution of each of the factors in the changing vegetation cover as a result. The preliminary results show that the annual rainfall is unchanged but that seasonal changes are high, the monsoon season is getting wetter and the dry season is getting dryer. NDVI based land use classification suggests that the pasture lands in the Gandaki river basin are decreasing while the forest land is increasing slightly. These findings can help pastoralists and policy makers improve planning of livestock management.

Dry seasons are becoming dryer and are expected to worsen in the future

The northern part of the Gandaki river (Trans-Himalayan region)—especially the Manang and Mustang districts—is an already dry region in Nepal, receiving the least amount of average annual rainfall (<250 mm). On the other hand, the basin consists of a place that receives the highest amount of annual rainfall—the Pokhara area. The Annapurna

Livestock grazing in pasturelands in the upstream regions of the Gandaki river basin, Nepal. (Photo credit: Jeeban Panthi)

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and Machhapuchhre mountain range causes an orographic (windward and lee ward side) effect which creates the contrasting rainfall sites in the basin. In turn, the annual precipitation in the dry season is decreasing significantly while it is increasing in the wetter regions (Panthi et al 2015). The dry season (post-monsoon and winter) in the basin is becoming dryer as identified from the observed historical data. The situation is expected to worsen in the future. PRECIS regional model data suggests that the dry area is becoming even dryer in terms of annual total precipitation. This negatively affects the forests, pasturelands, and the livestock smallholder. By contrast, the monsoon season—which is already wet—is getting wetter, therefore, there is a clear sign of too little water where it is needed but too much water where it is already excessive – causing drought in dry seasons and flooding and landslides in the monsoon season in the basin area.

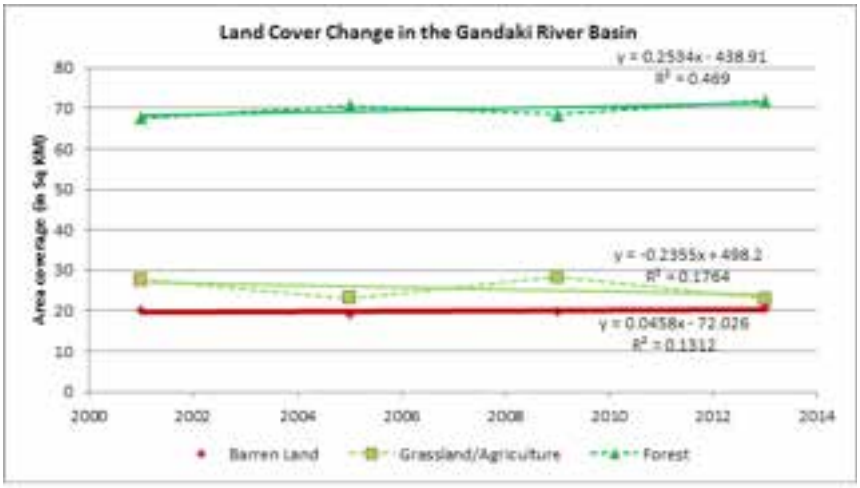

Figure 1: (Above) Land use change in the Gandaki river basin. The solid lines represent trends of the change.

Pastureland is decreasing while forest area is increasing in the Gandaki basin

The analysis of NDVI products from 2001 to 2013 for vegetation cover shows that the forest land is increasing in the Gandaki river basin while the pasture land is decreasing. This decrease in pastureland directly affects mountain livestock such as yak, Chauri, and sheep as their feed is supplied mainly from the pasturelands. On the other hands, those livestock in the lower parts of the basin have better feeding materials supplied from the increasing forest area. The dry/bare land remained the same throughout the study period. The lower part of the basin is dominated by forestlands but the higher part includes pasture lands, snow cover areas and bare lands.

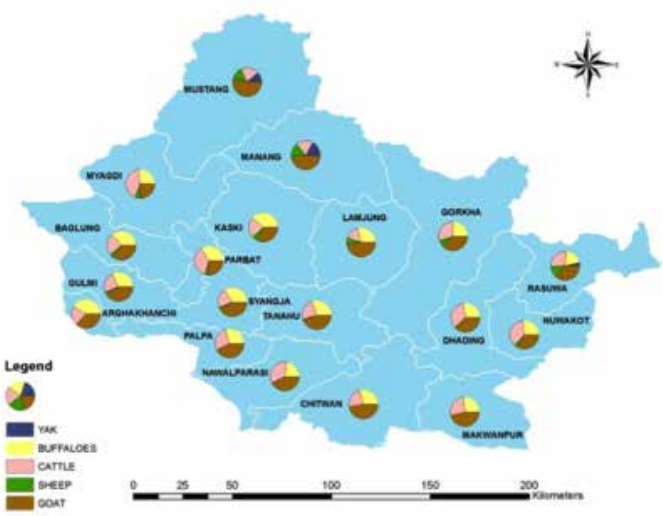

Figure 2: Livestock distribution over the Gandaki river basin.

Feed supply to livestock

Mountain ecosystems are considered highly sensitive to climate change because they are limited by low temperatures. For the same reason mountain ecosystems can be used as indicators of the impacts of climate change. Prolonged growing seasons and increased temperatures will remove some of the geographic environmental limitations and

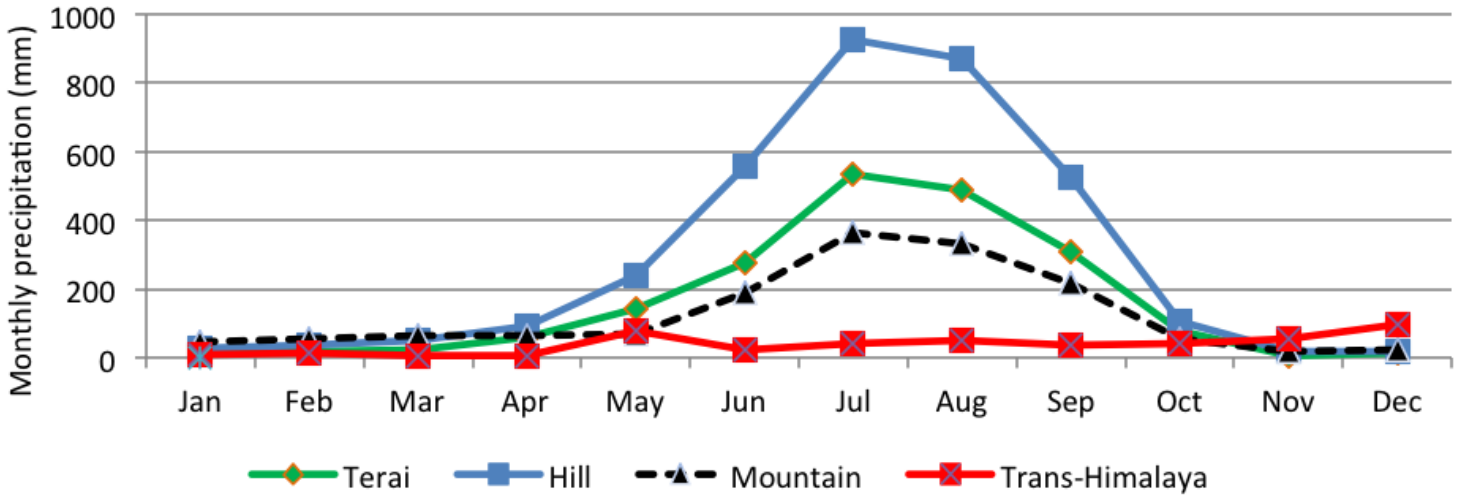

Figure 3: Monthly average precipitation in different agro-ecological zones of the Gandaki river basin.

Figure 4: Field after the fodder planting was damaged by a hailstorm in April. (Photo credit: Sushil Aryal)

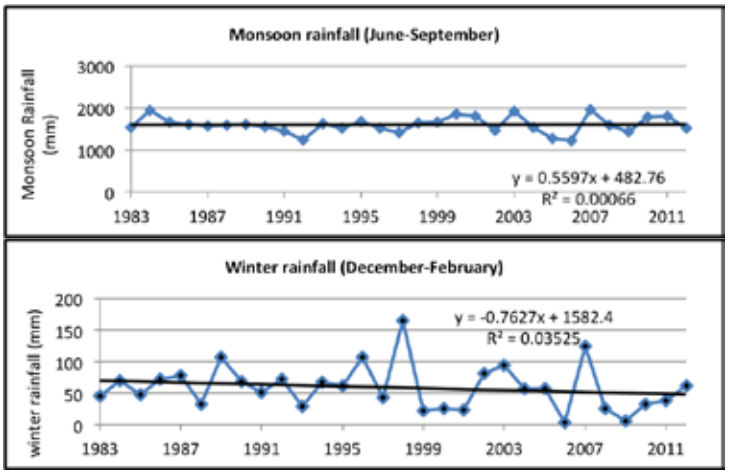

Figure 5: Rainfall trend in winter (upper) and monsoon (lower) seasons in the Gandaki river basin.

open the areas to invading plants from lower elevations, with an upward shift in distributions expected (Michelsen et al. 2011). On the other hand, decreasing snow cover is leaving more lands available for vegetation encroachment. Evidence gleaned from past climate change indicates that species are more likely to respond by migration rather than by genetic adaptation (Brian 1991). Further ecotonal shifts, changes in vegetation composition, and structural changes in vegetation are also likely responses of vegetation to climate change (Theurillat & Guisan 2001). Thornton et al. 2007 stated that one of the most evident and important effects of climate change on livestock production is mediated through changes in feed resources as changes in land use and systems, primary productivity of crops, forages and rangelands, species composition, and change in quality of plant material occurs. Apart from that, climate change impacts are reported on livestock genetics, breeding, and livestock health.

Policy implications

Decreasing rainfall in the trans-Himalayan areas and the resulting decrease in pasture land may significantly impact mountain livestock. Development and promotion of nutritious fodder species in the high mountain areas as well as water saving techniques are essential to develop livestock productivity in the areas. Mountain communities are preserving indigenous breeds of cattle such as the yak and Chauri, which need careful management for their long-term survival.. It is of high priority to identify appropriate sites for livestock species and enforce special provisions for developing site specific livestock systems in Nepal.

Figure 6: Yak grazing in Kanchanjungha area, eastern Himalayas of Nepal. (Photo credit: Jeeban Panthi)

Further Reading

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Prjoect: Adaptation for Climate Change by Livestock Smallholders in the Gandaki River Basin

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The joint project Livestock Innovation Lab and Small Earth Nepal project Adaptation for Climate Change by Livestock Smallholders in the Gandaki River Basin aims to support rural and broad-based empowerment targeting women and other disadvantaged populations within the context of economic diversification sectors. Specific objectives include: 1) understand local and regional climate change over recent decades using new applications of statistical methods to weather station and remote sensing data; 2) assess the impact of past and present climate variability and change on the health and food supply of livestock raised by small farmers and herders across elevation gradients in Gandaki River Basin (GRB) through field survey; and 3) work with and train village-based networks to devise pilot strategies for increasing livestock system resilience to climate hazards. Adaptation strategies will focus on water management and feed/forage crop production and onfarm research and demonstration sites wil be established to serve as platforms for technology transfer, outreach, and training.

Feed the Future Innovation Lab for Collaborative Research on Adapting Livestock Systems to Climate Change is dedicated to catalyzing and coordinating research that improves the livelihoods of livestock producers affected by climate change by reducing vulnerability and increasing adaptive capacity.

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