An Environmental Research Abstract

Headlines Himalaya

May 1 – May 15 (2022) No. 697 – 698 Editorial Team: Bibek Sapkota and Bimal Sharma

For the 697th - 698th issues of Headlines Himalaya, we reviewed researches from seven sources and selected nine researches from three countries. We selected three researches from Nepal and six researches from other Himalayan Countries (India and China).

Headlines Himalaya, a weekly research based fact file is an attempt to keep our global readers abreast with the happenings in the Himalaya. Please share it with your colleagues and friends. Also, subscription is free. Enjoy!

NEPAL

PREVALENCE OF ANTIBIOTIC RESISTANCE GENES IN DRINKING WATER OF THE KATHMANDU VALLEY, NEPAL

FISHING CAT PRIONAILURUS VIVERRINUS DISTRIBUTION AND HABITAT SUITABILITY IN NEPAL

ECOLOGICAL RISK ASSESSMENT OF TRANSBOUNDARY REGION BASED ON LAND-COVER CHANGE: A CASE STUDY OF GANDAKI RIVER BASIN, HIMALAYA

INDIA

LANDSCAPE HETEROGENEITY AFFECTS DIURNAL RAPTOR COMMUNITIES IN A SUB-TROPICAL REGION OF NORTHWESTERN HIMALAYAS, INDIA

REGIONAL MODULATING BEHAVIOR OF INDIAN SUMMER MONSOON RAINFALL IN CONTEXT OF SPATIO-TEMPORAL VARIATION OF DROUGHT AND FLOOD EVENTS

TREE DIVERSITY AND CARBON IMPORTANT SPECIES VARY WITH TRADITIONAL AGROFORESTRY MANAGERS IN THE INDIAN EASTERN HIMALAYAN REGION

ASIAN MONSOON AND VEGETATION SHIFT: EVIDENCE FROM THE SIWALIK SUCCESSION OF INDIA

CHINA

LIVELIHOOD SUSTAINABILITY OF HERDER HOUSEHOLDS IN NORTH TIBET, CHINA

QUANTITATIVE ANALYSIS OF VEGETATION RESTORATION AND POTENTIAL DRIVING FACTORS IN A TYPICAL SUBALPINE REGION OF THE EASTERN TIBET PLATEAU

PREVALENCE OF ANTIBIOTIC RESISTANCE GENES IN DRINKING WATER OF THE KATHMANDU VALLEY, NEPAL

Ocean Thakali, Bikash Malla, Sunayana Raya, Niva Sthapit, Samendra P. Sherchan, Takashi Furukawa, Kazunari Sei, Jeevan B. Sherchand, and Eiji Haramoto

Environmental Challenges 7: 100527

In resource-limited settings, fecal indicator bacterial analysis is the only microbiological water quality test performed, and emerging contaminants, such as antibiotic resistance genes (ARGs), are often neglected. To address this knowledge gap, water samples were collected from shallow wells (n = 24), deep wells (n = 16), stone spouts (n = 14), springs (n = 8), tanker filling stations (TFS; n = 12), water tankers (n = 12), and drinking water treatment plants (DWTPs; n = 6 each of raw and treated water) of the Kathmandu Valley, Nepal, between December 2015 and August 2016 to investigate the presence of five ARGs (bla_{NDM-1}, bla_{CTX-M}, *tetB, qnrS*, and *sul1*) and class one integrase gene (*intI1*). All ARGs were detected in water samples from shallow wells and stone spouts, whereas bla_{NDM-1} and bla_{CTX-M} were not detected in deep wells and springs. *tetB* and *intI1* were detected at a greater number of water tanker samples than TFS, indicating that water tankers were not disinfected regularly. Only *sul1* and *intI1* were detected in treated water of DWTPs. Persistence of *intI1* throughout the water treatment process and significantly strong correlation ($\rho > 0.5$, $p < 0.05$) with the majority of ARGs included in our study suggested the suitability of *intI1* to assess the contamination and fate of ARGs in drinking water of the valley. Low free chlorine levels in treated water before pipeline distribution urge water quality managers to evaluate tap water for pathogens and ARGs. Further studies are recommended on emerging contaminants, such as antibiotics, in drinking water sources that are not routinely assessed but can provide selective pressure for the spread of antibiotic resistance in the environment.

For further reading: https://doi.org/10.1016/j.envc.2022.100527

FISHING CAT *PRIONAILURUS VIVERRINUS* DISTRIBUTION AND HABITAT SUITABILITY IN NEPAL

Rama Mishra, Hans H. de Iongh, Hewig Leirs, Babu Ram Lamichhane, Naresh Subedi, and Shekhar S. Kolipaka

Ecology and Evolution 12: e8857

The fishing cat *Prionailurus viverrinus* is a wetland specialist species endemic to South and Southeast Asia. Nepal represents the northern limit of its biogeographic range, but comprehensive information on fishing cat distribution in Nepal is lacking. To assess their distribution, we compiled fishing cat occurrence records (n = 154) from Nepal, available in published literature and unpublished data (2009–2020). Bioclimatic and environmental variables associated with their occurrence were used to predict the fishing cat habitat suitability using MaxEnt modeling. Fishing cat habitat suitability was associated with elevation (152–302 m), precipitation of the warmest quarter, i.e., April–June (668–1014 mm), precipitation of the driest month (4–7 mm), and land cover (forest/grassland and wetland). The model predicted an area of 4.4% (6679 km^2) of Nepal as potential habitat for the fishing cat. About two-thirds of the predicted potentially suitable habitat lies outside protected areas; however, a large part of the highly suitable habitat (67%) falls within protected areas. The predicted habitat suitability map serves as a reference for future investigation into fishing cat distribution as well as formulating and implementing effective conservation programs in Nepal. Fishing cat conservation initiatives should include habitats inside and outside the

protected areas to ensure long-term survival. We recommend conservation of wetland sites, surveys of fishing cats in the identified potential habitats, and studying their genetic connectivity and population status.

For further reading: https://doi.org/10.1002/ece3.8857

ECOLOGICAL RISK ASSESSMENT OF TRANSBOUNDARY REGION BASED ON LAND-COVER CHANGE: A CASE STUDY OF GANDAKI RIVER BASIN, HIMALAYAS

Bohao Cui, Yili Zhang, Zhaofeng Wang, Changjun Gu, Linshan Liu, Bo Wei, Dianqing Gong, and Mohan Kumar Rai

Land 11: 638

Land-cover change is a major cause of global ecosystem degradation, a severe threat to sustainable development and human welfare. In mountainous regions that cross national political boundaries, sensitive and fragile ecosystems are under complex disturbance pressures. Land-cover change may further exacerbate ecological risks in these regions. However, few studies have assessed the ecological risks in transboundary areas. This study focused on the Gandaki Basin (GRB), a typical transboundary region in the Himalayas. Based on the dynamic change in land cover, the landscape ecological risk index (ERI) model was constructed to assess the ecological risk in the GRB, revealing the evolution characteristics and spatial correlation of such a risk during the period 1990–2020. The results showed that all land cover types in the GRB have changed over the last 30 years. The interconversion of cropland and forestland was a distinctive feature in all periods. Overall, the medium and medium to low ecological risk level areas account for approximately 65% of the study area. The areas of high ecological risk were mainly distributed in the high elevation mountains of the northern Himalayas, while the low risk areas were located in the other mountains and hills of Nepal. In addition, the ecological risk in the Gandaki basin has shown a fluctuating trend of increasing over the past 30 years. However, there were different phases, with the order of ecological risk being 2020 > 2000 > 2010 > 1990. Ecological risks displayed positive spatial correlation and aggregation characteristics across periods. The high–high risk clusters were primarily located in the high and medium high ecological risk areas, while the low–low risk clusters were similar to low risk levels region. The findings provided the reference for ecosystem conservation and landscape management in transboundary areas.

For further reading: https://doi.org/10.3390/land11050638

India-Himalaya

LANDSCAPE HETEROGENEITY AFFECTS DIURNAL RAPTOR COMMUNITIES IN A SUB-TROPICAL REGION OF NORTHWESTERN HIMALAYAS, INDIA

Sudesh Kumar, Asha Sohil, Muzaffar A. Kichloo, and Neeraj Sharma

PLoS ONE 17: e0246555

Raptors are highly sensitive to environmental and human-induced changes. In addition, several species of raptors exist in considerably small numbers. It is thus critical to conserve raptors and their habitats across relatively larger landscapes. We examined the diurnal raptor assemblages and seasonality in a subtropical habitat in India's northwestern Himalayas. Quantitative data on diurnal birds of prey and their habitat features across six distinct habitat types were collected from 33 sample sites. We observed 3,434 individuals of 28 diurnal raptors belonging

to two orders and three families during a two-year survey from December 2016 to November 2018. A significant variation in bird species richness and abundance was found across habitats and seasons, with farmlands and winters being the most diverse and speciose. The generalized linear model, used to determine raptor community responses, indicated that elevation and proximity to dumping sites significantly affected the raptor abundance. The non-metric multidimensional scaling (NMDS) revealed significant differences in raptor assemblages across the habitat types. The study concluded that raptors' persistence is largely determined by their preference for favourable feeding, roosting, and nesting opportunities. The presence of protected and habitat-exclusive species validates the high conservation importance of these ecosystems, particularly the forest patches and farmlands, necessitating robust conservation and management measures in this part of northwestern Himalaya.

For further reading: https://doi.org/10.1371/journal.pone.0246555

REGIONAL MODULATING BEHAVIOR OF INDIAN SUMMER MONSOON RAINFALL IN CONTEXT OF SPATIO-TEMPORAL VARIATION OF DROUGHT AND FLOOD EVENTS

Shruti Verma, R .Bhatla, N.K. Shahi, and R.K. Mall

Atmospheric Research 274: 106201

In this paper, daily modulating behaviors of Indian summer monsoon rainfall (ISMR) has been evaluated over eight important sub-zones of India viz Northwest India (NWI); Northcentral India (NCI); West Peninsular India (WPI); Eastern Peninsular India (EPI); Southern Peninsular India (SoPI); Central India (CI), Northeast India (NEI) and Western Ghat (WG) using latest SA-CORDEX simulated climate data during 1981–2015. The climate extreme indices, standardized precipitation index (SPI) and empirical orthogonal function (EOF) have been utilized to uncover substantial regional spatial patterns and temporal variability of monsoon precipitation over India and its sub regions to understand the regional modulation of these events based on duration, frequency and severity. The comprehensive assessment of ISMR modulated characteristics (intensity, spell, and frequency) were showing significant decreasing trend over NEI and NCI which can be leading factors for demarcating major hotspots for land degradation, effective management and adaptation towards water resources and hazards related to the flood/drought events. India has received flood events (1983, 1988, 1994, 2005, 2011, 2013) and drought event (1982, 1987, 2002, 2004 and 2009) during 1981–2015, which have been verified with SA-CORDEX RCMs (RegCM4.7, COSMO & REMO2015) using SPI. The first mode of EOF(IMD), explained 17% of the total SPI variability on the interannual scale, shows anomalous large positive values concentrated over the western peninsular region and extending towards central India as well as the NWI region of India. On the other hand, high anomalous negative values dominated over the NEI and eastern parts of the Indo-Gangetic Plain. Therefore, this study underscores the importance to uncover the prevalent dynamics and climate change variability on changing trend variability of the precipitation indices, drought and flood characteristics. As moderate to severe drought variability portrays a diversity over regional scale viz northwest India, north central India, eastern ghat of the southern peninsular region and northeast India while the occurrence of moderate to severe flood are dominated towards Himalaya region (26°N-35°N; 70°E-80°E), western peninsular region and western ghat.

For further reading: https://doi.org/10.1016/j.atmosres.2022.106201

TREE DIVERSITY AND CARBON IMPORTANT SPECIES VARY WITH TRADITIONAL AGROFORESTRY MANAGERS IN THE INDIAN EASTERN HIMALAYAN REGION

Panna Chandra Nath, Uttam Thangjam, Sidhartha Sankar Kalita, Uttam Kumar Sahoo, Krishna Giri, and Arun Jyoti Nath

Environmental Science and Pollution Research 29: 1-13

Traditional agroforestry systems, one of the time tested and dominant land use from tropical to sub-tropical regions, were recognized for their contributions to food production, biodiversity conservation, and atmospheric carbon sequestration. Their management often varies from region to region. However, these systems frequently mimic economically managed land uses due to increased pressure on the monetary requirement of their managers. The present study aims to evaluate (i) tree density, (ii) tree diversity indices, and (iii) identify the biomass carbon important tree species managed by different communities of the Indian Eastern Himalayan region. We found that the Mizo community harbored the highest number of tree species (35) in the traditional agroforestry system with the highest tree diversity index (3.47). Total biomass carbon of tropical agroforestry systems managed by different communities ranged between 4.72 Mg ha^{-1} (Meitei) and 29.26 Mg ha^{-1} (Bengali). Similarly, in the sub-tropical traditional agroforestry system, the highest and the lowest biomass carbon was observed in Mizo- (10.93 Mg ha^{-1}) and Angami- (6.05 Mg ha^{-1}) managed systems. Of the 31 biomass carbon, important species found across the traditional agroforestry systems, *Artocarpus heterophyllus*, had the highest occurrence (50%), followed by *Parkia timoriana* (37.5) and *Amoora rohituka*, *Delonix regia*, *Mangifera indica*, and *Toona ciliata* (25% for each species). Farmers' preference to cash return of a species, trees density, and basal area were the determinant factors in the carbon stock potential of these systems. The present study suggests that the farmers' preferred and dominant species in their agroecosystems have a limited scope of enhanced biomass carbon storage. Therefore, improvement of traditional agroforestry systems through selective incorporation of biomass carbon important tree species is recommended to enhance the carbon sink capacity of these systems.

For further reading: https://doi.org/10.1007/s11356-022-20329-4

ASIAN MONSOON AND VEGETATION SHIFT: EVIDENCE FROM THE SIWALIK SUCCESSION OF INDIA

Harshita Bhatia, Gaurav Srivastava, Purushottam Adhikari, Su Tao, Torsten Utescher, Khum N. Paudayal, and Rakesh C. Mehrotra

Geological Magazine 159: 1-18

Quantitative Miocene climate and vegetation data from the Siwalik succession of western Nepal indicate that the development of the Indian summer monsoon has had an impact, though in part, on vegetation changes. The climate and vegetation of the Lower (middle Miocene) and Middle (late Miocene–Pliocene) Siwalik successions of Darjeeling, eastern Himalaya, have been quantified. Reconstructed climate data, using the Coexistence Approach, suggest a decrease in winter temperatures and precipitation during the wettest months (MPwet) from the Lower to Middle Siwalik. The floristic assemblage suggests that Lower Siwalik forests were dominated by wet evergreen taxa, whereas deciduous ones became more dominant during the Middle Siwalik. The vegetation shift in the eastern Himalayan Siwalik was most likely due to a decrease in MPwet. The quantified climate–vegetation data from the eastern and western Himalayan Siwalik indicate that changes in the Indian summer monsoon had a profound impact on vegetation development during the period of deposition. We suggest that the decrease in winter temperature and summer monsoon rainfall during the Middle Siwalik might be linked with the Northern Hemisphere glaciation/cooling or a number of other things that were also going on at the time, including the continued rise of the Himalaya, and drying across the Tibetan region, which may have affected atmospheric circulation regionally.

For further reading: https://doi.org/10.1017/S0016756822000243

China Himalaya

LIVELIHOOD SUSTAINABILITY OF HERDER HOUSEHOLDS IN NORTH TIBET, CHINA

Huixia Zou, Shaowei Li, Huiyuan Zou, Wei Sun, Yingnan Niu, and Chengqun Yu

Sustainability 14*:* 5166

The livelihood sustainability of rural residents has attracted a great deal of attention across the globe, especially in remote mountain areas. In this study, we interviewed 696 householders who were randomly selected from 'Changtang' (also called 'North Tibet'), Tibetan Autonomous Region, China. Under the sustainable livelihood index (SLI) framework, we evaluated the livelihood sustainability of herder households and examined the differences between low- and high-sustainability groups. Our findings revealed the following: The livelihood sustainability of all herder households was generally low; low-sustainability households accounted for 87.07% of the samples. Social, human, and physical capitals accounted for 81.6% of the variance in the SLI of herder households. Less physical capital was the main reason for a lower SLI. Compared with high-SLI households, low-SLI families were characterized by having a higher dependency on natural resources, fewer fixed assets, weaker personal ability, and less participation in social organizations. Moreover, low-sustainability households were more vulnerable to medical expenses. Our study suggests that policymakers should pay closer attention to skills training, promote livelihood diversification, and strengthen social capital security. These actions are recommended for global poverty reduction and to promote the United Nations' Sustainable Development Goals.

For further reading: https://doi.org/10.3390/su14095166

QUANTITATIVE ANALYSIS OF VEGETATION RESTORATION AND POTENTIAL DRIVING FACTORS IN A TYPICAL SUBALPINE REGION OF THE EASTERN TIBET PLATEAU

Yu Feng, Juan Wang, Qin Zhou, Maoyang Bai, Peihao Peng, Dan Zhao, Zengyan Guan, and Xian'an Liu

PeerJ 10: e13358

Vegetation restoration is an essential approach to re-establish the ecological balance in subalpine areas. Changes in vegetation cover represent, to some extent, vegetation growth trends and are the consequence of a complex of different natural factors and human activities. Microtopography influences vegetation growth by affecting the amount of heat and moisture reaching the ground, a role that is more pronounced in subalpine areas. However, little research is concerned with the characteristics and dynamics of vegetation restoration in different microtopography types. The respective importance of the factors driving vegetation changes in subalpine areas is also not clear yet. We used linear regression and the Hurst exponent to analyze the trends in vegetation restoration and sustainability in different microtopography types since 2000, based on Fractional Vegetation Cover (FVC) and identified potential driving factors of vegetation change and their importance by using Geographical Detector. The results show that: (1) The FVC in the region under study has shown an up-trend since 2000, and the rate of increase is 0.26/year (P = 0.028). It would be going from improvement to degradation, continuous decrease or continuous significant decrease in 47.48% of the region, in the future. (2) The mean FVC is in the following order: lower slope (cool), lower slope, lower slope (warm), valley, upper slope (warm), upper slope, valley (narrow), upper slope (cool), cliff, mountain/divide, peak/ridge (warm), peak/ridge, peak/ridge (cool). The lower

slope is the microtopographic type with the best vegetation cover, and ridge peak is the most difficult to be afforested. (3) The main factors affecting vegetation restoration in subalpine areas are aspect, microtopographic type, and soil taxonomy great groups. The interaction between multiple factors has a much stronger effect on vegetation cover than single factors, with the effect of temperatures and aspects having the most significant impact on the vegetation cover changes. Natural factors have a greater impact on vegetation restoration than human factors in the study area. The results of this research can contribute a better understanding of the influence of different drivers on the change of vegetation cover, and provide appropriate references and recommendations for vegetation restoration and sustainable development in typical logging areas in subalpine areas.

For further reading: https://doi.org/10.7717/peerj.13358