An Environmental Research Abstract

Headlines Himalaya

August 1 – August 15 (2022) **No. 709 – 710** **Editorial Team: Pawan Rai and Sabita Badal**

For the 709th - 710th issues of Headlines Himalaya, we reviewed researches from four sources and selected 12 researches from five countries. We selected four researches from Nepal and eight researches from other Himalayan Countries (India, China, Bhutan, and Pakistan).

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ASSESSMENT OF THE VULNERABILITY OF FARMERS TOWARD CLIMATE CHANGE: A CASE FROM CHITRE-PARBAT OF NEPAL

Shobha Subedi, Anup K C, Basanta Dahal, and Ambika Ghimire

Journal of Environmental Studies and Sciences 12: 1 - 13

Climate change impacts are visible, ranging from local, national, and regional to the global scale. It disproportionately impacts the poor and those dependent on natural resources for their day-to-day livelihood activities. With an objective to assess the vulnerability of farmers to climate change, this study was conducted in the Chitre Village Development Committee (VDC) of the Panchase protected forest of Nepal. Seventy-one household surveys, two focused group discussions, and three key informant interviews were conducted to collect primary data. Temperature and precipitation data (from 1980 to 2020) were taken from the Department of Hydrology and Meteorology in Nepal. The maximum and minimum temperatures and pre-monsoon, post-monsoon, and winter rainfalls have increasing trends, while the monsoon rainfall has a decreasing trend. The maximum temperature has increased by 0.0415°C per year, and the annual rainfall has increased by 0.619 mm per year. Different parts of the study area have different levels of exposure, sensitivity, adaptive capacity, and vulnerability. The greater is the adaptive capacity, the lesser the vulnerability and the vulnerability index. Adaptive strategies must be incorporated with local knowledge and institutional support to achieve climate resilience.

For Further Reading: https://doi.org/10.1007/s13412-022-00778-6

FARMERS' PERCEPTIONS OF CLIMATE CHANGE IN LOWER MUSTANG, NEPAL

Ramesh Hamal, Bindu Malla Thakuri, Khagendra Raj Poudel, Anup Gurung, and Sun Jin Yun

Environmental Monitoring and Assessment 194: 606

Climate change has become one of the highlighted issues of the world, resulting in vulnerability and adverse effects on livelihoods. It leads to an undeniable challenge for policymakers, the government, and other respective associations to formulate effective strategies; however, before formulating any coping, adaptation, or mitigation strategies, understanding the reality and perception of local people is crucial. This study investigated whether local farmers inhabiting Lower Mustang are aware of climatic change. The study comprised various methodologies, such as household surveys, field visits and focus group discussions (FGD). The farmers' responses were consistent with the actual temperature and precipitation data recorded between 1973 and 2018 at meteorological stations situated near the aforementioned regions. The finding shows that the average annual temperature of this region has risen by 0.021 °C/year over the last 45 years. Similarly, the annual precipitation increased 1.83 mm/year on average, which was also acknowledged by local farmers. From the field visit, it was also noticed that the vulnerability of climate change is considerably high and has insufficient capacity to cope with climate change. Thus, the government, and other stakeholders should assist in building the adaptive capacity of this Himalayan region.

For Further Reading: https://doi.org/10.1007/s10661-022-10286-3

IMPACT OF CLIMATE CHANGE ON WATER RESOURCES AND CROP PRODUCTION IN WESTERN NEPAL: IMPLICATIONS AND ADAPTATION STRATEGIES

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Hydrology 9: 132

Irrigation-led farming system intensification and efficient use of ground and surface water resources are currently being championed as a crucial ingredient for achieving food security and reducing poverty in Nepal. The potential scope and sustainability of irrigation interventions under current and future climates however remains poorly understood. Potential adaptation options in Western Nepal were analyzed using bias-corrected Regional Climate Model (RCM) data and the Soil and Water Assessment Tool (SWAT) model. The RCM climate change scenario suggested that average annual rainfall will increase by about 4% with occurrence of increased number and intensity of rainfall events in the winter. RCM outputs also suggested that average annual maximum temperature could decrease by 1.4 °C, and average annual minimum temperature may increase by 0.3 °C from 2021 to 2050. Similarly, average monthly streamflow volume could increase by about 65% from March–April, although it could decrease by about 10% in June. Our results highlight the tight hydrological coupling of surface and groundwater. Farmers making use of surface water for irrigation in upstream subbasins may inadvertently cause a decrease in average water availability in downstream subbasins at approximately 14%, which may result in increased need to abstract groundwater to compensate for deficits. Well-designed irrigated crop rotations that fully utilize both surface and groundwater conversely may increase groundwater levels by an average of 45 mm from 2022 to 2050, suggesting that in particular subbasins the cultivation of two crops a year may not cause long-term groundwater depletion. Modeled crop yield for the winter and spring seasons were however lower under future climate change scenarios, even with sufficient irrigation application. Lower yields were associated with shortened growing periods and high temperature stress. Irrigation intensification appears to be feasible if both surface and groundwater resources are appropriately targeted and rationally used. Conjunctive irrigation planning is required for equitable and year-round irrigation supply as neither the streamflow nor groundwater can provide full and year-round irrigation for intensified cropping systems without causing the degradation of natural resources.

For Further Reading: https://doi.org/10.3390/hydrology9080132

SPATIO-TEMPORAL ANALYSIS OF VALLEY WIND SYSTEMS IN THE COMPLEX MOUNTAIN TOPOGRAPHY OF THE ROLWALING HIMAL, NEPAL

Helge Jentsch and Johannes Weidinger

Atmosphere 13: 1138

The diurnal, seasonal, and spatio-temporal characteristics of local wind systems in a steep mountain valley in Nepal are analyzed with the identification of valley wind days (VWDs). Distributed across the Rolwaling Himal valley in Nepal between 3700 and 5100 m a.s.l. at eight automated weather stations (AWSs), meteorological data between October 2017 and September 2018 were examined. VWDs were classified by means of ERA5 reanalysis data and in situ observations, employing established thresholds using precipitation, solar radiation, air pressure, and wind speed data at different pressure levels. Thus, overlying synoptic influences are highly reduced and distinctive diurnal patterns emerge. A strong seasonal component in near-surface wind speed and wind direction patterns was detected. Further analyses showed the diurnal characteristics of slow (approximately 0.5–0.9 m s^{-1}),

but gradually increasing wind speeds over the night, transitional periods in the morning and evening, and the highest averaged wind speeds of approximately 4.3 m s^{-1} around noon during the VWDs. Wind directions followed a 180° shift with nocturnal katabatic mountain winds and inflowing anabatic valley winds during the daytime. With AWSs at opposing hillsides, slope winds were clearly identifiable and thermally driven spatio-temporal variations throughout the valley were revealed. Consequently, varying temporal shifts in wind speed and direction along the valley bottom can be extracted. In general, the data follow the well-known schematic of diurnal mountain–valley wind systems, but emphasize the influence of monsoonal seasonality and the surrounding complex mountain topography as decisive factors.

For Further Reading: https://doi.org/10.3390/atmos13071138

India-Himalaya

MEDICINAL PLANTS USED AS THERAPEUTIC MEDICINE IN THE HIMALAYAN REGION OF AZAD JAMMU AND KASHMIR

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South African Journal of Botany 150: 194-216

The current research is the first quantitative ethno-botanical assessment of district Haveli in the Himalayan region, a remote and undiscovered territory of Azad Jammu & Kashmir (AJK). The people of the Himalayan region have a wealth of traditional knowledge that can be used to cure a variety of diseases. However, ethno-medicinal data must be recorded as soon as possible in order to preserve them and prevent extinction due to oral transmission, as well as to determine which remedies are still in use. Data was gathered from 70 informants (25 female and 45 male) through semi-structured interviews and group discussions. Informants were chosen at random or, in certain cases, using the snow-ball approach. To evaluate the gathered information, different ethnobotanical indices including UV, RFC, FL%, and ICF were used. Moreover, the information gathered in the current research work was contrasted with 22 different studies of aligned areas, including Pakistan. A total of 125 plant species used in herbal medicine were identified, which were distributed among 56 families and employed in 16 illness categories. Asteraceae (16 spp.) was the most used family in the area. The herbaceous life form was dominantly (66 spp., 53.65%) used in herbal preparation. The most commonly used part in herbal medicine was leaves (29.55%), and the most generally used method for preparing herbal recipes was extract (26.53%). The maximum ICF index value (0.92) was calculated for liver and digestive problems. The highest UV (0.92) was calculated for *Berginia virgata*. *Olea ferruginea* had the highest relative importance (100). Two plant species, *Berberis lycium* and *Thymus surphylum*, had 100% fidelity value. A high similarity was found with the study conducted on Devi Gali and Neelum valley with JI of 16.75 and 14.58. The plants with the highest levels of UV, RFC, RI, and FL would be examined for future pharmacological study in order to validate the findings and produce novel medications. Local residents have remained closer to nature due to their lack of communication with modern civilization. Despite the fact that they continued to employ medicinal plants in different herbal recipes, this tradition is on the verge of extinction since it is mostly retained by hakims, midwives, or the elderly people. The new generation is much less interested in traditional health practices due to advanced healthcare facilities and modern lifestyles.

For Further Reading: https://doi.org/10.1016/j.sajb.2022.07.007

LANDSCAPE USE AND CO-OCCURRENCE PATTERN OF SNOW LEOPARD (*PANTHERA UNICA*) AND ITS PREY SPECIES IN THE FRAGILE ECOSYSTEM OF SPITI VALLEY, HIMACHAL PRADESH

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PLoS ONE 17: e0271556

The snow leopard (*Panthera uncia*) plays a vital role in maintaining the integrity of the high mountain ecosystem by regulating prey populations and maintaining plant community structure. Therefore, it is necessary to understand the role of the snow leopard and its interaction with prey species. Further, elucidating landscape use and co-occurrence of snow leopard and its prey species can be used to assess the differential use of habitat, allowing them to coexist. We used camera trapping and sign survey to study the interactions of snow leopard and its prey species (Siberian Ibex- *Capra sibrica* and Blue sheep-*Pseudois nayaur*) in the Spiti valley Himachal Pradesh. Using the occupancy modelling, we examined whether these prey and predator species occur together more or less frequently than would be expected by chance. To understand this, we have used ten covariates considering the ecology of the studied species. Our results suggest habitat covariates, such as LULC16 (barren area), LULC10 (grassland), ASP (aspect), SLP (slope) and DW (distance to water), are important drivers of habitat use for the snow leopard as well as its prey species. Furthermore, we found that the snow leopard detection probability was high if the site was used by its prey species, i.e., ibex and blue sheep. Whereas, in the case of the prey species, the probability of detection was low when the predator (snow leopard) was present and detected. Besides this, our results suggested that both species were less likely to detect together than expected if they were independent (Snow leopard—Ibex, Delta = 0.29, and snow leopard—blue sheep, Delta = 0.28, both the values are <1, i.e., avoidance). Moreover, despite the predation pressure, the differential anti-predation habitat selection and restriction of temporal activities by the prey species when snow leopard is present allows them to co-exist. Therefore, considering the strong link between the habitat use by the snow leopard and its prey species, it is imperative to generate quantitative long-term data on predator-prey densities and the population dynamics of its prey species in the landscape.

For Further Reading: https://doi.org/10.1371/journal.pone.0271556

ENHANCED ATMOSPHERIC POLLUTION DUE TO UTTARAKHAND FIRE EVENT OF APRIL 2016 AND ITS RADIATIVE IMPACT

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Air Quality, Atmosphere and Health 15: 1-14

Forests, though very critical for life on Earth, are threatened by various factors and the frequently occurring forest fires are one of the significant causes. Forest fires drastically contribute to climate change on both regional and global scales. Forest fires—of both natural and anthropogenic origins—induce aerosols in the atmosphere and have a significant impact on the health and climate of the region. In this study, we simulate the Uttarakhand (29–31° N, 78–80° E) fire event in India, which occurred in April 2016, using the Weather Research and Forecasting with Chemistry (WRF-Chem) model to estimate the radiative impact of the aerosols emitted due to this fire event and probe into the extent of their transport into the atmosphere. Multiple data from ground-based and satellite observations are used to access the model performance. Our analysis showed that the high values of aerosol optical depths (AODs) during the fire event simulated by WRF-Chem compared very well with MODIS AODs over

the Uttarakhand region. The model simulations of the vertical profile of BC corroborate with elevated smoke aerosols derived from CALIPSO. An enhancement of smoke aerosols is observed up to 5-km altitude during the fire event both in the model simulations and observations. The fire has increased the near-surface air temperatures by 1–3 °C and decreased the relative humidity by ~ 10% over the affected areas. The NET (shortwave + longwave) atmospheric radiative forcing due to fire varied between ~ 10 and ~ 40 $W m^{-2}$ in the entire affected areas, with the highest values over the source region. The fire-induced atmospheric heating rate varied between 0.5 and 1.4 K/day over the Uttarakhand region.

For Further Reading: https://doi.org/10.1007/s11869-022-01234-8

DECLINE IN THE SUITABLE HABITAT OF DOMINANT *ABIES* SPECIES IN RESPONSE TO CLIMATE CHANGE IN THE HINDU KUSH HIMALAYAN REGION: INSIGHTS FROM SPECIES DISTRIBUTION MODELLING

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Environmental Monitoring and Assessment 194: 596

Reliable predictions of future distribution ranges of ecologically important species in response to climate change are required for developing effective management strategies. Here we used an ensemble modelling approach to predict the distribution of three important species of *Abies namely, Abies pindrow, Abies spectabilis* and *Abies densa* in the Hindu Kush Himalayan region under the current and two shared socioeconomic pathways (SSP245 and SSP585) and time periods of 2050 and 2090s. A correlative ensemble model using presence/absence data of the three Abies species and 22 environmental variables, including 19 bioclimatic variables and 3 topographic variables, from known distributions was built to predict the potential current and future distribution of these species. The individual models used to build the final ensemble performed well and provided reliable results for both the current and future distribution of all three species. For *A. pindrow*, precipitation of the driest month (Bio14) was the most important environmental variable with 83.3% contribution to model output while temperature seasonality (Bio4) and annual mean diurnal range (Bio2) were the most important variables for *A. spectabilis* and *A. densa* with 48.4% and 46.1% contribution to final model output, respectively. Under current climatic conditions, the ensemble models projected a total suitable habitat of about 433,003 km^2, 790,837 km^2 and 676,918 km^2 for *A. pindrow, A. spectabilis* and *A. densa*, respectively, which is approximately 10.36%, 18.91% and 16.91% of the total area of Hindu Kush Himalayan region. Projections of habitat suitability under future climate scenarios for all the shared socioeconomic pathways showed a reduction in potentially suitable habitats with a maximum overall loss of approximately 14% of the total suitable area of *A. pindrow* under SSP 8.5 by 2090. A decline in total suitable habitat is predicted to be 9.6% in *A. spectabilis* by 2090 under the SSP585 scenario while in *A. densa* 6.67% loss in the suitable area is expected by 2050 under the SSP585 scenario. Furthermore, there is no elevational change predicted in the case of *A. pindrow* while *A. spectabilis* is expected to show an upward shift by about 29 m per decade and *A. densa* is showing a downward shift at a rate of 11 m per decade. The results are interesting, and intriguing given the occurrence of these species across the Hindu Kush Himalayan region. Thus, our study underscores the need for consideration of unexpected responses of species to climate change and formulation of strategies for better forest management and conservation of important conifer species, such as *A. pindrow, A. spectabilis* and *A. densa.*

For Further Reading: https://doi.org/10.1007/s10661-022-10245-y

SPECIES CONSERVATION TARGET FOR FRESHWATER FISHES INHABITING BENGAL SUB-TROPICAL MONTANE RIVERS OF EASTERN HIMALAYAS: AN INDEXED VALUE APPROACH FOR PRIORITY DETERMINATION

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Aquatic Ecology 56: 1-24

Identifying conservation strategy is essential regarding prioritization, planning, and managing biodiversity. The Eastern Himalayan freshwater reaches contain diverse taxa of fish species. Despite having several coarse scales of assessment, the information regarding the fine-scale conservation priorities is scanty. The development of indices from multimeric attributes has been proved efficient, aiding conservation planning, in-depth research, exploitation, policy-making, and public awareness. Therefore, this study aims to provide detailed indexing of conservation values for the freshwater fish species inhabiting the sub-Himalayan Terai–Dooars ecoregion of the Eastern Himalayas. Based on three years of extended sampling in six freshwater reaches, 170 indigenous fish species were identified. Each fish species was assigned a discrete conservation value following their rarity, taxonomic singularity, contribution to β diversity, global threat status, regional importance, and maximal achievable body lengths. *Neolissochilus hexagonolepis* has the highest conservation value. In contrast, the lowest values were observed for *Pethia gelius, Pethia guganio,* and *Pethia phutunio*. The freshwater habitats of upper and lower elevation harbor essential fish species for conservation, driven by precipitation, topographic, and land cover variability. Such results were accomplished through spatial interpolation and prioritization regarding fish conservation, protection, and vulnerability toward the human footprint for this region of the Eastern Himalayas.

For Further Reading: https://doi.org/10.1007/s10452-022-09973-7

China-Himalaya

GLACIERNET2: A HYBRID MULTI-MODEL LEARNING ARCHITECTURE FOR ALPINE GLACIER MAPPING

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International Journal of Applied Earth Observation and Geoinformation 112: 102921

In recent decades, climate change has significantly affected glacier dynamics, resulting in mass loss and an increased risk of glacier-related hazards including supraglacial and proglacial lake development, as well as catastrophic outburst flooding. Rapidly changing conditions dictate the need for continuous and detailed observations and analysis of climate-glacier dynamics. Thematic and quantitative information regarding glacier geometry is fundamental for understanding climate forcing and the sensitivity of glaciers to climate change, however, accurately mapping debris-cover glaciers (DCGs) is notoriously difficult based upon the use of spectral information and conventional machine-learning techniques. The objective of this research is to improve upon an earlier proposed deep-learning-based approach, GlacierNet, which was developed to exploit a convolutional neural-network segmentation model to accurately outline regional DCG ablation zones. Specifically, we developed an enhanced GlacierNet2 architecture that incorporates multiple models, automatic post-processing, and basin-level hydrological flow techniques to improve the mapping of DCGs such that it includes both the ablation and accumulation zones. Experimental evaluations demonstrate that GlacierNet2 improves the estimation of the ablation zone and allows a high level of intersection over union (IOU: 0.8839) score, which is higher than the GlacierNet (IOU: 0.8599). The proposed architecture provides complete glacier (both accumulation and ablation zone) outlines at regional scales, with an overall IOU score of 0.8619. This is a crucial first step in automating complete glacier mapping that can be used for accurate glacier modeling or mass-balance analysis.

For Further Reading**: https://doi.org/10.1016/j.jag.2022.102921**

Bhutan-Himalaya

ANTIFUNGAL EFFICACY OF *HYPTIS SUAVEOLENS* AND *RUMEX NEPALENSIS* EXTRACTS AGAINST *ALTERNARIA SOLANI*: AN APPROACH FOR BIO-PESTICIDES

Bhagat Pokhrel and Deki Choden

Biocatalysis and Agricultural Biotechnology 43: 102439

Globally, early blight is one of the serious threats leading to significant reduction of potato yield. The use of plant extracts in the management of plant diseases is gaining global significance. Hence, the main objective of this study was to determine the antifungal activity of *Rumex nepalensis* and *Hyptis suaveolens* (L.) Poiteau extracts against the fungal pathogen (*Alternaria solani*) causing early blight in potato. The study employed experimental research method with completely randomized design wherein the plant extracts were tested against the pathogen through *in vitro* and *in vivo* studies. In the *in vitro* study, results from the poison food technique showed that the aqueous extracts of aerial parts of *R. nepalensis* (RnA) was the most efficient in reducing the diameter growth of the fungus than *R. nepalensis* roots (RnR) and *H. suaveolens* (HS). The efficacy of the extracts was in the decreasing order of RnA > RnR > HS at all concentrations (20%, 40% and 60%). The fungal biomass extraction showed similar trend with RnA having the highest Initial Activity on Biomass (IAB) followed by RnR and HS. Interestingly, the fungal biomass growth decreased with increase in concentration of all three extracts. In the in vivo technique, plants treated with RnA prior to infection exhibited better tolerance to the test pathogen. Comparatively, RnA showed less Disease Severity Index (DSI) than RnR and HS for both preventive and curative controls. Consequently, the percentage reduction of disease was recorded highest in RnA preventive control (71.43%) compared to other treatments. The preventive control showed lower DSI and higher reduction of disease compared to the curative control. Although all three extracts showed some degree of antifungal activity against *Alternaria solani*, RnA showed higher activity in both *in vitro* and *in vivo* treatments. Therefore, RnA extracts can be used as a potential bio-fungicide for the control of early blight in potato.

For Further Reading: https://doi.org/10.1016/j.bcab.2022.102439

Pakistan- Himalaya

LOCALIZED IMPACT OF LIVESTOCK SETTLEMENTS ON VEGETATION PATTERNS IN FIR FORESTS OF KASHMIR HIMALAYA

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Acta Ecologica Sinica 42: 407 - 416

Among the many global drivers of ecosystem degradation, the long-term impact of livestock settlements on vegetation patterns and composition, and is one of the greatest hurdles to successful forest ecosystem restoration. In order to identify the ecological implications of human land use changes on vegetation patterns and composition, the current study was conducted for the first time in Fir Forests of Kashmir Himalaya, to illustrate how vegetation responds to livestock settlements. We took samples from forest types both near and far from livestock settlements

(ALS and NLS, respectively). To collect data on forest types, we employed a systematic random sampling strategy. After evaluation of the important value index (henceforth IVI) for each plant species along with anthropogenic data of forests, we analyzed data using ordination and cluster analysis techniques. On comparative analysis, the lesser values for diversity indices have been found for at the forest types near livestock settlement. It was discovered that 36% species were unique to away from livestock settlements forest type and 18% species in near to livestock settlements forest type, but that maximum 46% of species were common to all forest types studied. Species composition was unevenly distributed along with various anthropogenic factors, according to the canonical correspondence analysis. Forests near livestock settlements were also discovered to affect species abundance and diversity by promoting the growth of weedy species. The abundant growth of weedy flora such as *Cirsium falconeri*, *Polygonum aviculare*, and *Urtica dioica* around livestock settlement, results in alterations of plant community composition. The findings revealed that cut trees contributed 16% of reported density at ALS forest type and considerably higher values 35% at NLS forest type, respectively. Findings of the study could be used to develop effective livelihood options and management policies for long-term forest harvest impacts in the Himalayas, resulting in the sustainable use of local forest reserves.

For Further Reading: https://doi.org/10.1016/j.chnaes.2022.07.004