An Environmental Research Abstract

Headlines Himalaya

September 01 – September 15 (2022) **No.713-714** **Editorial Team: Prakriti Pant and Sangeeta Chand**

For the 713th -714th issue of Headlines Himalaya, we reviewed news from eight sources and selected 11 researches from four countries. We selected four researches from Nepal and seven from other Himalayan countries (India, China and Bhutan)

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 *BROAD SCALE FUNCTIONAL CONNECTIVITY FOR ASIAN ELEPHANTS IN THE NEPAL-INDIA TRANSBOUNDARY REGION*

QUANTIFYING EFFECTS OF METEOROLOGICAL PARAMETERS ON AIR POLLUTION IN KATHMANDU VALLEY THROUGH REGRESSION MOFDELS

RESIDUAL EFFECT OF FINELY-GROUND BIOCHAR INOCULATED WITH BIO-FERTILIZATION IMPACT ON PRODUCTIVITY IN A LENTIL-MAIZE CROPPING SYSTEM

CLIMATE CHANGE-INDUCED DISTRIBUTIONAL CHANGE OF MEDICINAL AND AROMATIC PLANTS IN THE NEPAL HIMALAYA

INDIA *ANALYZING FREQUENT EXTREME FLOOD INCIDENCES IN BHRAMHAPUTRA BASIN, SOUTH ASIA*

TOPOGRAPHICAL IMPACT ON SNOW COVER DISTRIBUTION IN THE TRANS-HIMALAYAN REGION OF LADAKH, INDIA

CHINA *GRAZING PRESSURE INDEX CONSIDERING BOTH WILDLIFE AND LIVESTOCK CONSIDERING BOTH WILDLIFE AND LIVESTOCK IN THREE-RIVER HEADWATERS, QINGHAI-TIBETAN PLATEAU*

CONSIDERATION OF CLIMATE CHANGE IMPACTS WILL IMPROVE THE EFFICIENCY OF PROTECTED AREAS ON THE QINGHAI-TIBET PLATEAU

RESISTANCE OF GRASSLAND PRODUCTIVITY TO HYDROCLIMATIC CHANGES IN THE TIBETAN PLATEAU

BHUTAN *A PATTERN OF LIVESTOCK DEPREDATION BY SNOW LEOPARD TO THE YAK HERDING PASTORALIST IN WESTERN BHUTAN*

HYDROGEOCHEMICAL ASSESSMENT OF STREAMWATER QUALITY FOR ITS SUITABILITY FOR IRRIGATION: THE CASE OF MANTHONG VILLAGE, KANGLUNG (BHUTAN)

BROAD SCALE FUNCTIONAL CONNECTIVITY FOR ASIAN ELEPHANTS IN THE NEPAL-INDIA TRANSBOUNDARY REGION

Dinesh Neupane, Suraj Baral, Thomas S. Risch, and Campos-Arceiz

Journal of Environmental Management 321: 115921

The Nepal-India transboundary region hosts one of Asia's most complex large mammal assemblages, including a small (but growing) population of Asian elephants (*Elephas maximus*). These elephants occur in four widespread and geographically disjunct subpopulations, and some of them undergo seasonal transboundary movements. We conducted a broad-scale evaluation of the amount and quality of elephant habitat available in the region and of functional landscape connectivity between and within subpopulations using Maxent, circuit theory, and least-cost path analysis. Habitat suitability was highly influenced by abiotic geographical factors (altitude and precipitation) and less by ecological factors (habitat heterogeneity, plant productivity) and human disturbance (distance to settlements). The region had a relatively small amount of high and optimal suitability habitat (12.6% out of 93,700 km^2) but all subpopulations seem to be far from carrying capacity, suggesting ample potential for further population growth. Landscape connectivity was higher between and within the west and far-west subpopulations, which should be considered a single subpopulation. The central and east subpopulations, however, had low to very low between-subpopulation connectivity. Conservation priorities include maintaining the current connectivity in the west subpopulation and across the border in the east, and protecting high-quality habitats in eastern Nepal. Restoring connectivity between the central and other subpopulations is possible if the number of elephants continues growing, and it should be a long-term conservation aspiration. Maintaining and enhancing landscape connectivity in this region requires transboundary cooperation and coordination between Nepali and Indian authorities. If successful, it will bring considerable benefits for the conservation of elephants and other wildlife.

For Further Reading: https://doi.org/10.1016/j.jenvman.2022.115921

QUANTIFYING EFFECTS OF METEOROLOGICAL PARAMETERS ON AIR POLLUTION IN KATHMANDU VALLEY THROUGH REGRESSION MOFDELS

Srijan Lal Shrestha

Environmental Monitoring and Assessment 194: 684

Most studies on air pollution have focused on source apportionment aspect but very few have considered meteorological factors responsible for variation in air pollution levels including studies in Nepal. Consequently, the effects of meteorological parameters including effects of seasonality and lag effects are investigated and quantified for Kathmandu valley, Nepal. Daily temporal data of air pollution for 2017–early 2020 monitored by the Department of Environment and US Embassy, Kathmandu, Nepal, and meteorological data monitored by the Department of Hydrology and Meteorology, Kathmandu, Nepal, are used. Regression models namely exponential, Box-Cox transformed and Gamma generalized linear models are used to quantify the effects supported by regression diagnostics. Results depict high proportions of observed air pollution variations (79–85%) explained by the fitted models with varied effects of meteorological parameters. Around 5% reduction in PM_{10} (96% *CI*: 0.034–0.069) and PM_1 (95% *CI*: 0.029–0.063) levels per 1 °C increase in average temperature and significant increase in surface O_3 level (0.177, 95% *CI*: 0.126–0.228 Box-Cox transformed value) per 1 °C increase in average temperature

are detected. Similarly, around 0.7% (95% *CI*: 0.1–1.3) and 2% (96% *CI*: 1.3–2.5) decrease in PM_1 and PM_{10}, respectively per 1% increase in relative humidity, 0.032 (95% *CI*: 0.024–0.040) decrease in transformed value of $PM_{2.5}$ per 1 mm increase in rainfall, and 7.3% (95% *CI*: 1.3–15.9) decrease in PM_{10} per 1 m/s increase in wind speed are also detected. In conclusion, meteorological conditions are found significant contributing factors in determining air pollution levels in Kathmandu valley. On the long run, atmospheric conditions can play vital roles in air pollution situation shifts mainly due to climate change characterized by changes in meteorological values.

For Further Reading: https://doi.org/10.1007/s10661-022-10347-7

RESIDUAL EFFECT OF FINELY-GROUND BIOCHAR INOCULATED WITH BIO-FERTILIZATION IMPACT ON PRODUCTIVITY IN A LENTIL-MAIZE CROPPING SYSTEM

Amjad Ali, Wiqar Ahmad, Fazal Munsif, Aziz Khan, Jaya Nepal, Elżbieta Wójcik-Gront, Ijaz Ahmad, Muhammad Shahid Khan, Ikram Ullah, Sultan Akbar, Sajjad Zaheer, and Gang Jin

Agronomy 12: 2036

Biochar fertilization improves soil fertility and carbon sequestration, implying agricultural and environmental advantages. The effect of different sized previously applied biochar and biofertilizer agents on succeeding crops remains poorly known for legume–cereal cropping cycles. This study compared different particle-sized biochar and biofertilizer strains applied to lentils for their residual impact on subsequent maize growth, nutrition, and soil fertility without further polluting the environment. Three particle sizes (<2, 2–5, 5–10 mm) of Babul tree (*Acacia arabica*) wood biochar was obtained through grinding and sieving and applied prior to the lentil (first) crop at a rate of 500 g m^{-2}. The commercial *Rhizobium leguminosarum* products Biozote-N and Rhizogold were inoculated to lentil seeds before sowing. The effect of biochar and biofertilizer agents on the succeeding maize (second) crops was evaluated for soil and crop performance. Findings revealed that particle sizes of <2 mm biochar and Biozote-N inoculation enhanced plant height, leaf area and leaf area index, biological yield, and thousand grain weight of the subsequent maize crop. Maize grain yield was enhanced by 2.5%, tissue N uptake by 15%, nitrogen uptake efficiency by 17%, grain protein content by 15%, extractable P by 17%, and soil bulk density by 3% with a residual biochar particle size of <2 mm and Biozote-N inoculation. It was concluded that the finely grounded (<2 mm) biochar particle combined with inoculation of Biozote-N was superior to larger particle sizes for enhancing crop growth and improving soil fertility status at the residual level, benefiting the subsequent crop in a legume–cereal rotation system.

For further reading: https://doi.org/10.3390/agronomy12092036

CLIMATE CHANGE-INDUCED DISTRIBUTIONAL CHANGE OF MEDICINAL AND AROMATIC PLANTS IN THE NEPAL HIMALAYA

Uttam B. Shrestha, Pramod Lamsal, Suresh K. Ghimire, Bharat B. Shrestha, Sajita Dhakal, Sujata Shrestha, and Kishor Atreya

Ecology and Evolution 12: e9204

Medicinal and aromatic plants (MAPs) contribute to human well-being via health and economic benefits. Nepal has recorded 2331 species of MAPs, of which around 300 species are currently under trade. Wild harvested MAPs in Nepal are under increasing pressure from overexploitation for trade and the effects of climate change and development. Despite some localized studies to examine the impact of climate change on MAPs, a consolidated understanding is lacking on how the distribution of major traded species of MAPs will change with future climate

change. This study identifies the potential distribution of 29 species of MAPs in Nepal under current and future climate using an ensemble modeling and hotspot approach. Future climate change will reduce climatically suitable areas of two-third of the studied species and decrease climatically suitable hotspots across elevation, physiography, ecoregions, federal states, and protected areas in Nepal. Reduction in climatically suitable areas for MAPs might have serious consequences for the livelihood of people that depend on the collection and trade of MAPs as well as Nepal's national economy. Therefore, it is imperative to consider the threats that future climate change may have on distribution of MAPs while designing protected areas and devising environmental conservation and climate adaptation policies.

For further reading: https://doi.org/10.1002/ece3.9204

India-Himalaya

ANALYZING FREQUENT EXTREME FLOOD INCIDENCES IN BHRAMHAPUTRA BASIN, SOUTH ASIA

Amit Kumar, Subhasree Mondal, and Preet Lal

Plos One 17: e0273384

The present study is focused on the flood inundation in Brahmaputra Basin, which is one of the most recurrent and destructive natural disasters of the region. The flood inundation was assessed using C-Band Sentinel 1A synthetic aperture radar (SAR) during 2015–2020 with precipitation patterns, runoff discharge, and their impacts on land cover in the basin. The study exhibited a very high precipitation during monsoon in the upper catchment resulting in severe flood inundation in downslopes of Brahmaputra Basin. A very high (900–2000 mm) to extremely high (>2000 mm) monthly cumulative precipitation in the south and south-eastern parts of basin led to high discharge (16,000 to 18,000 m^3 s^{-1}) during July-August months. The river discharge increases with cumulative effects of precipitation and melting of snow cover during late summer and monsoon season, and induced flood inundation in lower parts of basin. This flood has largely affected agricultural land (>77% of total basin), forests (~3%), and settlement (426 to 1758 km^2) affecting large wildlife and livelihood during 2015– 2020. The study highlights the regions affected with recurrent flood and necessitates adopting an integrated, multi-hazard, multi-stakeholder approach with an emphasis on self-reliance of the community for sustenance with local resources and practices.

For Further Reading: https://doi.org/10.1371/journal.pone.0273384

TOPOGRAPHICAL IMPACT ON SNOW COVER DISTRIBUTION IN THE TRANS-HIMALAYAN REGION OF LADAKH, INDIA

Stanzin Passang, Susanne Schmidt, and Marcus Nüsser

Geosciences 12:311

This article presents the distribution of seasonal snow cover in the Trans-Himalayan region of Ladakh over the observation period of 2000–2019. Seasonal snow cover area and duration have been monitored and mapped based on the MODIS Normalised Difference Snow Index (NDSI). Using different MODIS cloud removal algorithms, monthly mean cloud-covered areas have been reduced to 3%. Pixel-wise approaches using Mann–Kendall (MK) and Sen's slope trend tests allow to assess seasonal and annual trends of snow cover days (SCD) and snow cover area (SCA) across seven delineated subregions of Ladakh. Analyses include the impact of topographical parameters (elevation, slope, aspect). Overall, the mean annual SCA amounts to 42%, varying from 15% in August to 71% in

February. However, large differences of SCA have been detected between and within subregions. The trend analysis of SCA shows a non-significant, slight increase for summer as well as for the entire year and a decrease for spring and winter seasons. The SCD trend analysis indicates more pixels with a significant increase than a decrease. In total, 12% of all pixels show an increasing trend in summer, 6% over the entire year, 3% in autumn, and 2% in spring and winter, whereas less than 2% of all pixels show a decreasing trend in all seasons. The results are important for regional irrigated agricultural production and freshwater supply in the context of climate change.

For further reading: https://doi.org/10.3390/geosciences12080311

China Himalaya

GRAZING PRESSURE INDEX CONSIDERING BOTH WILDLIFE AND LIVESTOCK CONSIDERING BOTH WILDLIFE AND LIVESTOCK IN THREE-RIVER HEADWATERS, QINGHAI-TIBETAN PLATEAU

Zhenyuan Cai, Pengfei Song, Junbang Wang, Feng Jiang, Chengbo Liang, Jinjie Zhang, Hongmei Gao, and Tongzuo Zhang

Ecological Indicators 143: 109338

Grassland is not only the natural habitats for the survival of wild animals, but also the material guarantees for livestock husbandry. However, the previous studies on grassland carrying capacity are mostly only considering livestock but wild herbivores were ignored. In this study, the population of large wild herbivores, Tibetan wild ass, Tibetan gazelle and Tibetan antelope, and livestock were surveyed, and the grassland forage yield was estimated by a remote sensing-process coupled model in Qumahe Township in Three-River Headwaters, Qinghai-Tibetan in 2020. The actual carrying capacity (AC) was calculated from the both wildlife and livestock and the theoretical carrying capacity (TC) in the term on edible herbage and crude protein was estimated. Grazing pressure index was measured by the ratio of AC to TC in this region. The results showed the AC was contributed by about 20,700 standard sheep units (SHU) from wild large herbivores, and 256,500 SHU from the livestock. The theoretical carrying capacity of edible herbage, which is 274,800 SHU, was lower than the theoretical carrying capacity of crude protein in the region. If only considering livestock, the grazing capacity pressure index is 0.93, but the index will be 1.01 if the both wildlife and livestock were considered, and wildlife contributes 7.5% to the grazing pressure. This study suggested the wildlife population should be calculated in grassland ecological carrying capacity estimation though domestic livestock contributed much more to grazing pressure than wild herbivores. The new indicator would be useful in grassland management to maintain ecosystem and biodiversity balance, and society-economy sustainability.

For Further Reading: https://doi.org/10.1016/j.ecolind.2022.109338

CONSIDERATION OF CLIMATE CHANGE IMPACTS WILL IMPROVE THE EFFICIENCY OF PROTECTED AREAS ON THE QINGHAI-TIBET PLATEAU

Zijian Lu, Liangxu Wang, Nan Meng, Xuhuan Dai, Jingyi Zhu, Yanzheng Yang, Ruonan Li, Jinfeng Ma, and Hua Zheng

Ecosystem Health and Sustainability 8: 2117089

The protection of migratory birds and their habitats is of great importance to the ecological stability and sustainability of the entire Qinghai-Tibet Plateau (QTP) and its surrounding areas. Most currently protected areas (PAs) were designed in accordance with species distribution patterns that were established under current climatic

conditions, thus ignoring climate change will lead to a decrease in the protection efficiency of these PAs. In this study, using the flagship migratory bird *Grus nigricollis*, the black-necked crane, as an example, we used the maximum entropy (MaxEnt) ecological niche model to simulate the current and future distributions and conservation status of *G. nigricollis* and optimized the existing PA boundaries on the QTP. The results of the study showed that (1) suitable habitat- for *G. nigricollis* accounts for approximately 12.48% of the QTP area, and the PAs established under current climatic conditions cover 17.84% of this suitable habitat area; (2) future climate changes will greatly influence the distribution and quality of *G. nigricollis* habitats, and the average protection efficiency of the current PAs in four climatic scenarios will decrease from 17.84% to 15.31%; and (3) through optimization, the efficiency of existing PAs can be significantly increased by 0.75 times and reach 28.37%, indicating that PA planning must consider not only current climate conditions but also the effects of climate changes. Our results aim to address shortcomings in the conservation efficiency of PAs in the future and provide an example for resolving mismatched PA boundaries and habitat changes for migratory birds.

For Further Reading: https://doi.org/10.1080/20964129.2022.2117089

RESISTANCE OF GRASSLAND PRODUCTIVITY TO HYDROCLIMATIC CHANGES IN THE TIBETAN PLATEAU

Na Zeng, Zhongen Niu, Pan Li, Xiaobo Zhu, and Xiaoli Ren

Ecological Indicators 143: 109351

An increasing trend of hydroclimatic disturbances, such as droughts, which are projected to become more frequent and intense with global warming and climate change. Droughts adversely affect the structure and function of terrestrial ecosystems, damage vegetation growth, and even increase mortality. In this study, we assess the drought resistance (R_d) of ecosystems in the Tibetan Plateau. Ecosystem water use efficiency (WUE) was used as an indicator of change in carbon and water cycles, and then ecosystem resistance in terms of change in WUE in drought years was analyzed. Our results suggested that the WUE in the Tibetan Plateau exhibited significant spatial heterogeneity and drastically reduced under dry and cool conditions. The evaluation of ecosystem drought resistance indicated that the grassland in most areas of the Tibetan Plateau is resistant to hydroclimatic fluctuations. In particular, the grassland ecosystem in areas with lower temperatures or higher precipitation exhibited greater drought resistance. Our results facilitate the identification of drought-vulnerable areas in the Tibetan Plateau to inform grassland ecosystem management and climate policy-making and sustain ecosystem stability under future climate conditions.

For Further Reading: https://doi.org/10.1016/j.ecolind.2022.109351

Bhutan-Himalaya

A PATTERN OF LIVESTOCK DEPREDATION BY SNOW LEOPARD TO THE YAK HERDING PASTORALIST IN WESTERN BHUTAN

Phub Dorji and Reta Bahadur Powre

Pastoralism 12:33

The pastoralists co-exist with wild predators and livestock depredation by predators causes an immense impact on the livelihood of the herders and instigates a negative attitude towards the conservation of these wild predators. Yak herders in western Bhutan move from place to place for herding on pasture and they face challenges with

livestock predation by top predators like snow leopard (*Panthera uncia*) and dhole (*Cuon aplinus*). To investigate patterns of livestock depredation by the snow leopard and determine the attitude of herders towards snow leopard conservation, we conducted a household interview with all 56 itinerant yak herders in the west of Bhutan. Each herd was keeping a mean of 84 (± 29) yaks per herd. Yaks were mainly kept for milk and bulls for breeding and bullocks for meat to sustain their family livelihood. Predation of livestock by predators (42.9%) was among the top problems faced by the yak herders. A total of 398 yaks were lost to snow leopards (78.86%) followed by dhole (18.3%), Himalayan black bear (*Ursus thibetanus*) (2.7%), and common leopard (*Panthera pardus*) (0.2%) in the past 5 years (2015–2019). The majority (87.22.8%) of the kills by snow leopards were young yak and most (60.5%) kills were recorded during summer. Snow leopards are considered harmful (73.2%), and herders (71.1%) are not in favour of snow leopard conservation. Herders' conflict with snow leopards is severe in the current study site, and we recommend social development for conservation programmes like livelihood alternatives for the herders, compensation and insurance schemes, and conservation awareness programmes for the yak herders as an intervention to create harmonic co-existence between the yak herder and the snow leopard.

For Further Reading: https://doi.org/10.1186/s13570-022-00247-3

HYDROGEOCHEMICAL ASSESSMENT OF STREAMWATER QUALITY FOR ITS SUITABILITY FOR IRRIGATION: THE CASE OF MANTHONG VILLAGE, KANGLUNG (BHUTAN)

Tshewang Dendup, Pema Lekzin, Tshewang Lhendup, and Sonam Tobgay

Water Supply 22: 7125-7139

Mountain streams/springs are the primary irrigation water resource in Bhutan Himalaya, besides supporting drinking and other domestic needs. Successful crop production implies an adequate supply of high-quality irrigation water, among other factors. Thus, this study was conducted to assess the suitability of spring-fed streamwater for irrigation use and evaluate hydrogeochemical processes that regulate streamwater chemistry at the Manthong village in Kanglung, Bhutan. The water samples were analyzed for temperature, pH, electrical conductivity (EC), turbidity, total dissolved solute (TDS) and major ions. Piper and Durov diagrams indicated that most samples are of the intermediate type and simple dissolution or linear mixing is the primary hydrochemical process regulating streamwater chemistry. All the measured physicochemical parameters were within the acceptable thresholds of the FAO guidelines recommended for agricultural use. Analytical results of the streamwater water quality indices, including EC, %Na, residual sodium bicarbonate (RSBC), sodium adsorption ratio (SAR), Kelley's ratio (KR) and permeability index (PI), revealed its suitability for irrigation use except for magnesium hazard (MH). The Irrigation Water Quality Index (IWQI) results confirmed that the WS-1 has no restriction as irrigation water; however, WS-2 falls under the high-restriction category. The findings of this study will serve as the baseline data and guide irrigation water management and sustainable irrigation development in the region.

For further reading: https://doi.org/10.2166/ws.2022.299

Highlight of the Issue

Climate Change and Flood

The flood in Pakistan has killed more than 1,200 people and 33 million are affected. The devastating flood was caused by several factors, including intense heatwaves, glacial melt and stronger monsoon conditions enhancing the rainfall, which are linked to climate change. Researchers suggest that the catastrophe started with phenomenal heatwaves and that in April and May temperatures reached over 40 degrees Celsius. This increase in temperatures led to the melting of glaciers in the northern mountainous region, increasing the amount of water in the Indus River. Due to the early arrival of the monsoon on June 30, the rainfall was observed to be three times more than the average so far. As a result, the southern provinces of Sindh and Bauchistan have received more than five times the average rainfall. Some weather agencies have also predicted that the ongoing La Niña climate event is enhancing the rainfall in Pakistan. This large scale weather event had also caused the major flood in Pakistan in 2010. The two large scale weather events knows as El Nino (warming phase) and La Niña (cooling phase) are two opposite phenomena of the El Nino Southern Oscillation (ENSO). During this event, the cooler sea surface temperature over the central and eastern Pacific causes stronger trade winds and storms. This causes more rainfall in Southeast Asian region and Australia and reduced rainfall in Horn of Africa and Western U.S. The recent La Niña event started in 2020 and has entered its third year in 2022. Researchers believe that the triple-year La Niña can be observed in times when the impacts of global warming exacerbates ENSO and when the phenomena is affected by a warming atmosphere and oceans.

https://www.nature.com/articles/d41586-022-02813-6

https://www.downtoearth.org.in/news/climate-change/la-nina-s-rare-triple-dip-likely-to-affect-weather-patterns-globally-84690

https://www.bbc.com/news/science-environment-62915648

https://texasclimatenews.org/2022/09/22/a-leading-scientist-explains-2022s-supercharged-summer-of-climate-extremes/