An Environmental Research Abstract

Headlines Himalaya

September 1 - September 15 (2020) No. 617-618 Editorial Team: Gaurav Kumar Raut and Anueva Acharya

For the 617th - 618th issues of Headlines Himalaya, we reviewed journal articles from nine sources and selected seventeen researches from five countries. We selected six researches from Nepal and eleven researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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CLIMATE CHANGE, RISK PERCEPTION, AND PROTECTION MOTIVATION AMONG HIGH-ALTITUDE RESIDENTS OF THE MT. EVEREST REGION IN NEPAL

Neelam C. Poudyal, Omkar Joshi, Donald G. Hodges, Hem Bhandari, and Pramod Bhattarai

Ambio 49: 1-14

Mountain ecosystems are considered vulnerable to early impacts of climate change. Whether and how local residents of these areas perceive these changes, however, remain under-studied questions. By conducting a household survey in the Khumbu region of Nepal, this study assessed local residents' experience-based perception of changes in climate trends and patterns, perceived risk, and attitudes towards climate issues. Multivariate cluster analysis based on residents' climate change beliefs revealed three segments: "Cautious," "Disengaged," and "Alarmed." A comparison of these segments along key psychosocial constructs of Protection Motivation Theory (PMT) revealed significant inter-segment differences in residents' perception of severity, vulnerability, response efficacy, self-efficacy, and response cost associated with engaging in mitigating behavior. Results shed light on how residents of high elevation areas that are considered to be exposed to early impacts of climate change perceive the risk and intend to respond. These findings could also assist stakeholders working in other similar mountain ecosystems in understanding vulnerability and in working towards climate readiness.

For Further Readings: https://doi.org/10.1007/s13280-020-01369-x

INVESTIGATION OF AEROSOL CLIMATOLOGY AND LONG-RANGE TRANSPORT OF AEROSOLS OVER POKHARA, NEPAL

Jeevan Regmi, Khem N Poudyal, Amod Pokhrel, Madhu Gyawali, Lekhendra Tripathee, Arnico Panday, Anthony Barinelli, and Rudra Aryal

Atmosphere 11: 874

This study presents the spectral monthly and seasonal variation of aerosol optical depth (τ_{AOD}), single scattering albedo (SSA), and aerosol absorption optical depth (AAOD) between 2010 and 2018 obtained from the Aerosol Robotic Network (AERONET) over Pokhara, Nepal. The analysis of these column-integrated aerosol optical data suggests significant monthly and seasonal variability of aerosol physical and optical properties. The pre-monsoon season (March to May) has the highest observed τ_{AOD}(0.75 ± 0.15), followed by winter (December to February, 0.47 ± 0.12), post-monsoon (October and November, 0.39 ± 0.08), and monsoon seasons (June to September, 0.27 ± 0.13), indicating seasonal aerosol loading over Pokhara. The variability of Ångström parameters, α, and β, were computed from the linear fit line in the logarithmic scale of spectral τ_{AOD}, and used to analyze the aerosol physical characteristics such as particle size and aerosol loading. The curvature of spectral τ_{AOD}, α', computed from the second-order polynomial fit, reveals the domination by fine mode aerosol particles in the post-monsoon and winter seasons, with coarse mode dominating in monsoon, and both modes contributing in the pre-monsoon. Analysis of air mass back trajectories and observation of fire spots along with aerosol optical data and aerosol size spectra suggest the presence of mixed types of transboundary aerosols, such as biomass, urban-industrial, and dust aerosols in the atmospheric column over Pokhara.

For further Reading: https://doi.org/10.3390/atmos11080874

FOREST COVER CHANGE PATTERN AFTER THE INTERVENTION OF COMMUNITY FORESTRY MANAGEMENT SYSTEM IN THE MID-HILL OF NEPAL: A CASE STUDY

Shankar Tripathi, Rajan Subedi, and Hari Adhikari

Remote Sensing 12: 2756

An account of widespread degradation and deforestation in Nepal has been noticed in various literature sources. Although the contribution of community forests (CF) on the improvement of forest cover and condition in the Mid-hill of Nepal is positive, detailed study to understand the current situation seems important. The study area (Tanahun District) lies in the Gandaki Province of western Nepal. The objective of this study was to estimate the forest cover change over the specified period and to identify factors influencing the change. We used Landsat images from the years 1976, 1991, and 2015 to classify land use and land cover. We considered community perception in addition to the forest cover map to understand the different causes of forest cover change. Forest cover decreased from 1976 to 1991 annually at a rate of 0.96%. After 1991, the forest increased annually at a rate of 0.63%. The overall forest cover in the district regained its original status. Factors related to increasing forest cover were emigration, occupation shift, agroforestry practices, as well as particularly by plantation on barren lands, awareness among forest users, and conservation activities conducted by local inhabitants after the government forest was handed over to community members as a community forest management system.

For further Reading: https://doi.org/10.3390/rs12172756

VEGETATION CHANGES AND THEIR RESPONSE TO GLOBAL CHANGE BASED ON NDVI IN THE KOSHI RIVER BASIN OF CENTRAL HIMALAYAS SINCE 2000

Xue Wu, Xiaomin Sun, Zhaofeng Wang, Yili Zhang, Qionghuan Liu, Binghua Zhang, Basanta Paudel, and Fangdi Xie

Sustainability 12: 6644

Vegetation forms a main component of the terrestrial biosphere owing to its crucial role in land cover and climate change, which has been of wide concern for experts and scholars. In this study, we used MODIS (moderate-resolution imaging spectroradiometer) NDVI (Normalized Difference Vegetation Index) data, land cover data, meteorological data, and DEM (Digital Elevation Model) data to do vegetation change and its relationship with climate change. First, we investigated the spatio-temporal patterns and variations of vegetation activity in the Koshi River Basin (KRB) in the central Himalayas from 2000 to 2018. Then, we combined NDVI change with climate factors using the linear method to examine their relationship, after that we used the literature review method to explore the influence of human activities to vegetation change. At the regional scale, the $NDVI_{GS}$ (Growth season NDVI) significantly increased in the KRB in 2000–2018, with significant greening over croplands in KRB in India. Further, the croplands and forest in the KRB in Nepal were mainly influenced by human interference. For example, improvements in agricultural fertilization and irrigation facilities as well as the success of the community forestry program in the KRB in Nepal increased the $NDVI_{GS}$ of the local forest. Climate also had a certain impact on the increase in $NDVI_{GS}$. A significant negative correlation was observed between $NDVI_{GS}$ trend and the annual minimum temperature trend (TMN) in the KRB in India, but an insignificant positive correlation was noted between it and the total annual precipitation trend (PRE). $NDVI_{GS}$ significantly decreased over a small area, mainly around Kathmandu, due to urbanization. Increases in $NDVI_{GS}$ in the KRB have thus been mainly affected by human activities, and climate change has helped increase it to a certain extent.

For further Reading: https://doi.org/10.3390/su12166644

APPLICATION OF DEEP NEURAL NETWORK TO CAPTURE GROUNDWATER POTENTIAL ZONE IN MOUNTAINOUS TERRAIN, NEPAL HIMALAYA

Ananta Man Singh Pradhan, Yun-Tae Kim, Suchita Shrestha, Thanh-Canh Huynh, and Ba-Phu Nguyen

Environmental Science and Pollution Research 27: 1-17

This study aims to capture groundwater potential zones integrating deep neural network and groundwater influencing factors. The present work was carried out for Gopi khola watershed, mountainous terrain in Nepal Himalaya as the watershed mainly relies upon the groundwater assets; it is a need to explore groundwater potential for better management of the aquifer framework. Ten groundwater influencing factors were collected such as elevation, slope, curvature, topographic positioning index, topographic roughness index, drainage density,

topographic wetness index, geology, lineament density, and land use thematic layers. Among those influencing factors, topographic roughness index was removed because of multicollinearity issue to reduce the dimension of the dataset. A spring inventory map of 145 spring locations was prepared using field survey method and an equal number of spring absence points were randomly generated. The 70% of spring and spring absence pixels were used as training dataset and remaining as test dataset. The final map was created based on predicted probabilities ranging from 0 to 1. The validation was done using the receiver operating characteristic curve, which shows that the area under the curve is 76.1% for the training dataset and 82.1% for the test dataset. The sensitivity analysis was performed using Jackknife test which shows that the lineament density is the most important factor. The experimental results demonstrated that deep neural network is highly capable to capture groundwater potential zone in mountainous terrain. The present study might be useful and preliminary work to exploit the groundwater. The consequences of the current study may be valuable to water administrators to settle on appropriate choices on the ideal utilization of groundwater assets for future arranging in the basic investigation zone.

For further Reading: https://doi.org/10.1007/s11356-020-10646-x

FLOOD VULNERABILITY AND ITS INFLUENCING FACTORS

Santosh Pathak, Hari Krishna Panta, Thaneshwar Bhandari, and Krishna Prasad Paudel

*Natural Hazards*103: 1-22

Riverine floods are the major weather-related disaster affecting both agriculture production and physical infrastructures in Nepal. Climatic factors aggravated by anthropogenic measures contribute to increasing household-level vulnerability in the country. We use face-to face interview data collected from 217 households located in the Saptari district of Nepal to understand the household-level vulnerability of farmers impacted by floods. Our model combines variables of household sensitivity, adaptive capacity, and exposure to flooding in an integrated vulnerability index to assess the vulnerability status of households and factors influencing the vulnerabilities. Findings indicate a high vulnerability level of most households stems from higher exposure to flood and lower adaptive capacity. Using the ordinal response model, we find that indicators such as credit access, migration, female proportion, and perception and familiarity with flood incidences positively influence the vulnerability. However, gender, livestock owned, per capita income, adaptation measures, and distance to water bodies have a negative influence on the vulnerability level. These findings can be used to tailor micro-level policies to minimize the impact of floods in the district. Governmental level effort, such as river control strategy, is needed to minimize the flood risk at a larger scale in the future.

For further Reading: https://doi.org/10.1007/s11069-020-04267-3

PALAEOENVIRONMENT SHIFTS DURING LAST~500 YEARS AND EUTROPHIC EVOLUTION OF THE WULAR LAKE, KASHMIR VALLEY, INDIA

Rayees Ahmad Shah, Hema Achyuthan, Aasif Lone, Pankaj Kumar, Asif Ali, and Abdur Rahman

Limnology 21*: 1*-10

Multi-proxy analysis of lake sediments provides high-resolution and reliable palaeoclimate records. The present study aims to investigate the palaeoenvironmental changes and eutrophic evolution of the Wular Lake, Kashmir Valley spanning the last ~500 years. Based on the multi-proxy analysis and supported by radiocarbon chronology, two prominent environmental phases were identified. From 74 to 45 cm, the sedimentation corresponds to the late 15th to early sixteenth century suggests the influence of cold, Little Ice Age (LIA) with nutrient-poor lacustrine environmental conditions. The following climate phase (28–9 cm) reflects the 19th and early twentieth century warmer and wetter environmental conditions. Enhanced TOC and N nutrient inputs in the lake sediments observed during the top 25 cm are likely contributed by anthropogenic sources owing to rapid and sustained anthropogenic land-use of watershed environments. This increase in the lake nutrients has been caused due to intense agriculture and horticulture practices leading to the lake eutrophication.

For further readings**:** https://doi.org/10.1007/s10201-020-00639-7

INTEGRATION OF SOCIAL, ECONOMIC AND ENVIRONMENTAL FACTORS IN GIS FOR LAND DEGRADATION VULNERABILITY ASSESSMENT IN THE PIR PANJAL HIMALAYA, KASHMIR, INDIA

Shakil Ahmad Romshoo, Muzamil Amin, K.L.N. Sastry, and Manish Parmar

Applied Geographic 125:102307

Land degradation assessment is imperative for developing a mitigation plan to minimize the adverse impacts associated with land degradation. The study involves the integration of various social, economic and environmental indices for identifying the land degradation vulnerable areas in the Pir Panjal Himalaya, Kashmir, India. Analysis of the land use and land cover from the satellite data revealed that ~47% of the area is devoid of any vegetal cover. Slope index revealed that ~40% of the study area is precipitous with slope >30%. The land utilization index indicated that ~51% of the area is over-utilized. Integration of all the environmental indices in GIS environment yielded the Natural Resource Prioritization Index which revealed that ~41% of the area needs attention for land degradation mitigation on top priority. Integration of all the socioeconomic indices yielded the Socio-Economic Priority Zones which revealed that ~35% of the area needs attention for the socio-economic

upliftment on priority for combating the land degradation in the study area. Land Degradation Vulnerability Index (LDVI) model was developed in GIS environment based on the unique combination of various natural resource and socioeconomic priority zones using the weighted index approach to assess the cumulative impact of social, economic and environmental factors on land degradation. The model analyses revealed that ~48% of the study area (~603 Km^2) shows high to very high LDVI values alluding to its high vulnerability to different forms of land degradation. The approach developed in this research for the integration of various causal factors to identify the lands vulnerable to varying degree and intensity of degradation will go a long way in developing appropriate mitigation strategies for combating land degradation at village level in the Himalaya

For further readings**:** https://doi.org/10.1016/j.apgeog.2020.102307

GENETIC DIVERSITY AND POPULATION STRUCTURE OF AN INVASIVE PLANT SPECIES DIFFER IN TWO NON-NATIVE REGIONS WITH DIFFERING CLIMATE AND INVASION SUCCESS

Tanvir-Ul-Hassan Dar, Basharat Ahmed Bhat, Anzar Ahmad Khuroo, Sushil Verma, and Shahid Ul Islam

Nordic Journal of Botany 38: 1-9

One of the fundamental questions in invasion biology is why an alien species successfully invades one region but fails to do so in another region. In this regard, the recently emerging molecular ecology tools have made it possible to understand the genetic basis of invasion success and/or failure of alien species in different regions. Here we report the results of studies of the population genetic structure and diversity of *Parthenium hysterophorus* L. – a global plant invader – from two climatically distinct Himalayan regions: Jammu and Kashmir. While *P. hysterophorus* has successfully invaded across the subtropical Jammu region, it failed to invade the neighbouring temperate Kashmir region. The results, based on the ISSR data, revealed that the populations from Jammu were genetically more diverse than those from Kashmir. This conclusion was further supported by cluster analysis which grouped all the five populations *of P. hysterophorus* from Jammu region, but clearly separated out the Kashmir population. It is plausible that this low genetic diversity of *P. hysterophorus* in the latter region, along with the environmental barrier (i.e. temperate climate), has so far prevented the naturalisation and wide spread of this invasive plant species in Kashmir. The research insights from the present study, therefore, have potential implications for understanding the genetic basis of plant invasions.

For further readings**:** https://doi.org/10.1111/njb.02742

GC/MS CHARACTERIZATION, *IN-VITRO* ANTIOXIDANT, ANTI-INFLAMMATORY AND ANTIMICROBIAL ACTIVITY OF ESSENTIAL OILS FROM *PINUS* PLANT SPECIES FROM HIMACHAL PRADESH, INDIA

Aditi Sharma, Lalit Sharma, and Rohit Goyal

Journal of Essential Oil Bearing Plants 23: 522-531

The present study was aimed to explore the chemical composition and evaluate the biological efficacy of needles and stem bark oils of three Pine plant species: *Pinus roxburghii, P. wallichiana,* and *P. gerardiana* for oxidative, inflammatory and infectious diseases. The essential oils of three *Pinus* plants (needles and bark) were obtained by hydrodistillation and analyzed using GC/MS. The essential oils were further assessed for antioxidant, anti-inflammatory, and anti-microbial activities *in-vitro*. The antimicrobial activity was assessed against four bacterial strains by using agar well diffusion test. The antioxidant activity was evaluated utilizing the DPPH free radical scavenging assay and Nitric oxide assay. The GC/MS analysis leads to the identification of compounds in essential oils of *P. roxburghii, P. wallichiana,* and *P. gerardiana*. The oils showed significant anti-oxidant activity by scavenging DPPH and nitric oxide. The oils also showed promising *in-vitro* anti- inflammatory activities on albumin denaturation assay and HRBC membrane stabilization assay. The oils showed significant inhibition in the growth of microorganisms: *Escherichia coli*, *Pseudomonas aurignosa*, *Staphylococcus aureus,* and *Klebsiella pneumonia,* when compared to control. The observed results back the suggestion that non-polar constituents from the essential oils of *Pinus* plant species have the biological potential to treat oxidative, inflammatory, and bacterial infections. This may derive rationale for the medicinal properties of *Pinus* oil lends credence to age-old use and holds for the production of novel drugs.

For further readings: https://doi.org/10.1080/0972060X.2020.1803147

REVIEW ON *TRILLIUM GOVANIANUM* WALL. EX D. DON: A THREATENED MEDICINAL PLANT FROM THE HIMALAYAS

Shalika Rathore, Swati Walia, Renu Devi, and Rakesh Kumar

Journal of Herbal Medicine 24: 100395

Trillium govanianum Wall. ex D. Don (Family Trilliaceae) is a threatened medicinal plant of the Himalayan region that has much therapeutic value. It is also known as Himalayan trillium or Nagchhatri with important phytoconstituents named as steroid saponins which are extensively used in the pharmaceutical industry. The root extract of plants has analgesic, anti-inflammatory, anticancer, antifungal and wound healing properties. Acknowledging the significance of this plant, this review aims to explore the historical background, morphology, distribution, chemical properties and pharmacological activities together with the chemical constituents of it.

Efforts should be made to protect it in its natural habitat. The present review also deals with agro-techniques and conservational aspects of the plant.

For further readings: https://doi.org/10.1016/j.hermed.2020.100395

China Himalaya

ELEVATION DEPENDENT WARMING OVER THE TIBETAN PLATEAU: PATTERNS, MECHANISMS AND PERSPECTIVES

Qinglong You, Deliang Chen, Fangying Wu, Nick Pepin, Ziyi Cai, Bodo Ahrens, Zhihong Jiang, Zhiwei Wu, Shichang Kang, and Amir AghaKouchak

Earth-Science Reviews 210:103349

The Tibetan Plateau (TP) is also known as the "Third Pole". Elevation dependent warming (EDW), the phenomenon that warming rate changes systematically with elevation, is of high significance for realistically estimating warming rates and their impacts over the TP. This review summarizes studies of characteristics and mechanisms behind EDW over the TP based on multiple observed datasets and model simulations. Spatial expression of EDW and explanatory mechanisms are still largely unknown because of the lack of suitable data over the TP. The focus is on the roles played by known mechanisms such as snow/ice-albedo feedback, cloud feedback, atmospheric water vapor feedback, aerosol feedback, and changes in land use, ozone and vegetation. At present, there is limited consensus on the main mechanisms controlling EDW. Finally, new perspectives and unresolved issues are outlined, including quantification of EDW in climate model simulations, explanation of the long-term EDW reconstructed from proxies, interaction between the Asian summer monsoon and EDW, importance of EDW for future environmental changes and water resources, and current gaps in understanding EDW over extremely high elevations. Further progress requires a more comprehensive ground observation network, greater use of remote sensing data, and high-resolution climate modeling with better representation of both atmospheric and cryospheric processes.

For Further Readings: https://doi.org/10.1016/j.earscirev.2020.103349

A CLIMATIC PERSPECTIVE ON THE IMPACTS OF GLOBAL WARMING ON WATER CYCLE OF COLD MOUNTAINOUS CATCHMENTS IN THE TIBETAN PLATEAU: A CASE STUDY IN YARLUNG ZANGBO RIVER BASIN

Zhicheng Xu, Lei Cheng, Peng Luo, Pan Liu, Lu Zhang, Fapeng Li, Liu Liu, and Jie Wang

Water 12: 2338

Global warming has a profound influence on global and regional water cycles, especially in the cold mountainous area. However, detecting and quantifying such changes are still difficult because noise and variability in observed

streamflow are relatively larger than the long-term trends. In this study, the impacts of global warming on the catchment water cycles in the Yarlung Zangbo River Basin (YZRB), one of most important catchments in south of the Tibetan Plateau, are quantified using a climatic approach based on the relationship between basin-scale groundwater storage and low flow at the annual time scale. By using a quantile regression method and flow recession analysis, changes in low flow regimes and basin-scale groundwater storage at the Nuxia hydrological station are quantified at the annual time scale during 1961–2000. Results show annual low flows (10th and 25th annual flows) of the YZRB have decreased significantly, while long-term annual precipitation, total streamflow, and high flows are statistically unchanged. Annual lowest seven-day flow shows a significantly downward trend (2.2 $m^3/s/a$, $p < 0.05$) and its timing has advanced about 12 days (2.8 day/10a, $p < 0.1$) during the study period. Estimated annual basin-scale groundwater storage also shows a significant decreasing trend at a rate of 0.079 mm/a ($p < 0.05$) over the study period. Further analysis suggests that evaporation increase, decreased snow-fraction, and increased annual precipitation intensity induced by the rising temperature possibly are the drivers causing a significant decline in catchment low flow regimes and groundwater storage in the study area. This highlights that an increase in temperature has likely already caused significant changes in regional flow regimes in the high and cold mountainous regions, which has alarming consequences in regional ecological protection and sustainable water resources management.

For Further Readings: https://doi.org/10.3390/w12092338

CHANGES IN GRASSLAND COVER AND IN ITS SPATIAL HETEROGENEITY INDICATE DEGRADATION ON THE QINGHAI-TIBETAN PLATEAU

Chengxiu Li, Rogier de Jong, Bernhard Schmid, Hendrik Wulf, and Michael E. Schaepman

Ecological Indicators 119: 106641

Arid grassland ecosystems undergo degradation because of increasing environmental and human pressures. Degraded grasslands show vegetation cover reduction and soil-patch development, leading to grassland fragmentation and changes in spatial heterogeneity. Understanding grassland degradation that involves soil-patch development remains a challenge over large areas with limited accessibility such as the Qinghai-Tibetan Plateau. We hypothesized that vegetation cover, its spatial heterogeneity and changes thereof over time retrieved from satellite data can indicate grassland development and degradation levels. To test the hypothesis, we studied these indicators from 2000 to 2016 and related them to previously described degradation levels on the eastern Qinghai-Tibetan Plateau (QTP) in 2004. We further use these indicators to map the new grassland development and degradation levels in 2016. We found that lower vegetation cover does not always indicate a more severe degradation; instead, higher spatial heterogeneity is a better correlate of degradation. Combined temporal changes in grassland cover and its spatial heterogeneity are related to the literature-defined degradation levels. We found that grassland areas on the eastern QTP have moved into new degradation stages from 2000 to 2016

using changes in grassland cover and its spatial heterogeneity as indicators. The normalized difference vegetation index (NDVI) as a proxy for grassland cover declined over time in the literature-defined degraded areas but increased in the desert areas from 2000 to 2016. Spatial heterogeneity generally increased across different degradation levels from 2000 to 2016; however, this increase was less pronounced in severely degraded and slightly deserted areas. Our newly defined degradation levels in 2016 included degradation, desertification, and improving levels. Across our study area, 63% of all areas were classified as degraded and 2% were at risk of desertification. The remaining areas (35%) classified as improving and re-growing occurred in higher-elevation or previously severely degraded grassland. Our study demonstrates that a combination of changes in grassland cover and in its spatial heterogeneity can indicate grassland degradation levels and serve as an early-warning signal for desertification threats.

For further readings: https://doi.org/10.1016/j.ecolind.2020.106641

A BIG LANDSLIDE ON THE JINSHA RIVER, TIBET, CHINA: GEOMETRIC CHARACTERISTICS, CAUSES, AND FUTURE STABILITY

Yulong Cui, Pengpeng Bao, Chong Xu, Gui Fu, Qisong Jiao, Yi Luo, Lingling Shen, Xiwei Xu, Fenglin Liu, Yuejun Lyu, Xiuhong Hu, Tao Li, Yongsheng Li, Yimin Liu, and Yunfeng Tian

Natural Hazards 103: 1-20

On October 10, 2018, a big landslide occurred on the right bank of the Jinsha River in Baige Village, Polo Township, Jiangda County, Tibet (hereafter called the Baige landslide), which blocked the Jinsha River, forming a barrier lake. Afterward, the landslide dam broke, producing a flood. On November 3, the rear wall of this landslide failed again, also blocking the Jinsha River and creating a bigger barrier lake. Then, by local people, a discharge channel was excavated on the top of the landslide dam, making lake water cross over the discharge channel. As the water flow gradually increased, the landslide dam broke again, producing a more severe flood, resulting in huge economic losses downstream. The purpose of this study is to understand the cause of this landslide and predict the future stability of its head scarp, providing some support for the control scheme in the later stage. A digital orthophoto map (DOM) and a digital elevation model (DEM) of the landslide were created using an unmanned aerial vehicle. Then based on the DOM and DEM, the geometric characteristics of the landslide were described. Multi-phase Planet 5 images were used to infer the development process of the landslide. Finally, the cause of the landslide was analyzed based on the rainfall data and the limit equilibrium calculation. The results show that the Baige landslide was a self-weight creeping event, and its development and trigger were independent of the rainfall. Before the landslide, the slope experienced five stages of evolution: steady deformation, slow deformation, rapid deformation, steady deformation, and rapid deformation. The limit equilibrium calculation indicates that the stability coefficient of the middle section of the head scarp is the lowest, thus which should be cut down as a

priority. This study provides a typical example of a self-weight creep type landslide, and an important reference for prediction and prevention of similar large landslides in the Tibetan Plateau, southwestern China.

For further readings: https://doi.org/10.1007/s11069-020-04261-9

Bhutan-Himalaya

SURVEY, IDENTIFICATION AND GENETIC DIVERSITY OF PHYTOPHTHORA CAPSICI CAUSING WILT OF CHILLI (*CAPSICUM ANNUUM L.*) IN BHUTAN

Ganja S. Rai , Edward C. Y. Liew, and David. I. Guest

European Journal of Plant Pathology 158: 655-665

Chilli (*Capsicum annuum L.)* is one of the most important crops in Bhutan, but currently production is seriously affected by a wilt disease. Although chilli wilt was first reported in Bhutan in 1995, the causal pathogen has never been formally identified. The aim of this study was to identify the causative agent of wilt epidemics on chilli in Bhutan and to investigate the morphological and genetic variations in the pathogen. A survey of the disease was conducted in all three chilli growing regions of Bhutan in 2018 and the pathogen isolated from 54 diseased plants. Morphological and PCR evidence identified the pathogen as *Phytophthora capsici* in 100% of the diseased plants. All isolates were of the A1 mating type. Four random amplified micro-satellite (RAMS) markers were employed to assess genetic variation among the 54 isolates of *P. capsici* collected. Genetic analysis showed 26 loci from all four primers and 65.4% of the isolates were polymorphic. Shannon's index of diversity (I) for the *P. capsici* isolates collected was 0.42, indicating that the pathogen population is highly clonal. These findings have significant implications for the development of sustainable disease management strategies including resistant genotypes in Bhutan.

For Further Readings: https://doi.org/10.1007/s10658-020-02108-4

Pakistan- Himalaya

ETHNOPHARMACOLOGICAL APPROACHES OF THE NATIVE HILL PEOPLE OF MURREE AND KOTLI SATTIAN, DISTRICT RAWALPINDI, PROVINCE OF PUNJAB, PAKISTAN

Bilal Javed, Wajiha Seerat, Abdullah Sarwer, and Zia-ur-Rehman Mashwani

Botany Letters 167: 1-17

Mountains greatly affect the climate of an area because of differences in altitude, latitude, topography and continental position which provide special eco geographic habitats to diverse plant species having different systematic and pharmacological attributes. The present investigation aimed to explore the ethnomedicinal formulations used by the native hill people living on the Murree and Kotli Sattian situated 50 Km away from the capital Islamabad. An ethnobotanical survey led to the collection of 21 plant families and 34 species distributed among 30 genera. Fabaceae (12%), Plantaginaceae (12%), Rosaceae (9%) and Apocynaceae (9%) were the most common families, accounting for 42% of the reported medicinal plant species of the area. During this investigation, 63% of the collected plant species were used only in ethnopharmacological formulations. The use of extracts (57%) and oral (60%) administration of the drugs prepared from different parts of the plants, especially leaves (23%), were the most common. 526 URs (use reports) were collected and diseases were assorted into 25 major categories. In general, 21 URs were collected against each disease category and 15 URs against each reported plant species. Digestive disorders, respiratory ailments, skin issues along with joint and muscular pains were found prevailing among the hill people, which shows a direct relationship with the climate of the area. The results of this study show that the hills of the Murree and Kotli Sattian are endowed with a high biodiversity and occupants of the hills use a large array of plants to treat their diseases.

For further readings: https://doi.org/10.1080/23818107.2020.1806106