An Environmental Research Abstract

Headlines Himalaya

For the 667th - 668th issues of Headlines Himalaya, we reviewed researches from six sources and selected 13 researches from four countries. We selected two researches from Nepal and 11 researches from other Himalayan countries (India, China, and Pakistan).

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Nepal-Himalaya

AGAINST THE TIDE: THE FUTURE OF TRANSHUMANT HERDERS IN THE KAILASH SACRED LANDSCAPE OF NEPAL

Binaya Pasakhala, Rucha Ghate, Karma Phuntsho, Popular Gentle, Janita Gurung, Ashok Shrestha, Kamala Gurung, and Sunil Thapa

Mountain Research and Development 41: R8-R15

Transhumant pastoralism, with its cultural, ecological, and socioeconomic significance, is an important livelihood strategy for mountain communities. Despite its importance, transhumant pastoralism is declining in the Hindu Kush Himalayan region. This study examines the drivers of change experienced by transhumant herders in Bajhang, western Nepal, in order to understand future implications for transhumant pastoralism in the region. Here, animals are raised to transport goods to remote villages and to earn supplemental income through the sale of milk, meat, and livestock. The study found that herders are experiencing multiple drivers of changes—including socioeconomic, political, institutional, ecological, and climatic—which have both positive and negative implications for their livelihoods. Herders have responded to these changes by altering their transhumance routes and by reducing the variety and numbers of animals raised. The increasing market demand for meat from freely grazed animals and limited road access are current factors contributing to the perpetuation of transhumant herding in Bajhang. Meanwhile, the institutional mechanisms provisioned in the National Rangeland Policy are neither functional in the study area nor able to resolve issues of the herders. The study recommends developing an incentive-based mechanism involving herders and other stakeholders to address the challenges faced by herders.

For further reading: https://doi.org/10.1659/MRD-JOURNAL-D-20-00073.1

PRODUCTION, DISTRIBUTION, USE AND TRADE OF *VALERIANA JATAMANSI* JONES IN NEPAL

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Global Ecology and Conservation 30: e01792

Sugandhawal (*Valeriana jatamansi* Jones) is a sub-tropical and temperate traditional medicinal plant, folkloric in Nepal for epilepsy, cholera and neurosis and is used as analgesic, antispasmodic, antiseptic, carminative, diuretic, expectorant and sedative. It serves as a promising source for household economy, primary healthcare and herbal market and remedies, but it is being harvested and traded without considering its sustainability. Thus, the study of

its distribution, production, use, trade and conservation is prerequisite to understand its socio-ecological interactions as well as to guide its sustainable production in the future. We used both primary and secondary data collection methods, and qualitative and quantitative analyses for assessment of production, distribution and use of *V. jatamansi*. This included laying out 453 quadrats (2 m * 2 m) for inventory plots and 51 group discussions. The occurrence points of *V. jatamansi* were mapped. We compiled the use records of *V. jatamansi* at district level by reviewing available ethnobotanical studies carried out so far in Nepal and trade records from *Hamro Ban* publication (1998 – 2017). Finally, we modeled the potential distribution of *V. jatamansi* using a maximum entropy model (MaxEnt) with the help of 201 presence locations collected from the field surveys and secondary references and 20 predictive variables. From the field data, a total of 51 hilly and mountainous districts from east to west were found growing *V. jatamansi* however, the production and distribution of species were greatly varied and found in 55 districts including those 51. The potential distribution of this species is likely to be expanded northward in mountainous areas with the highest scope in western Nepal. There is a significant convergence between potential distribution and current distribution (production, collection points of species and forest cover) of species. The number of districts with records of production, use and trade of Valeriana were 55, 47 and 39 respectively. A total of 16 use types and 121 use reports were recorded under ethnobotanical uses. The use of *V. jatamansi* rhizomes in household economy had the highest relative importance value (RIL) (0.18) followed by use for subsistence (0.17), primary health care (0.09), and culture (0.09). Despite the decade-long credentials of growing and traditional uses, *V. jatamansi* has been traded in markets and exported only after 1995. Now, *V. jatamansi* is found as a major ingredient of local livelihood in remote and rural areas of Nepal. Management of current and potential distribution areas, application of sustainable harvesting practices and promotion of cultivation in off-forest and highlands lead the sustainability of species and local livelihood.

For further reading: https://doi.org/101016/j.gecco.2021.e01792

India-Himalaya

ETHNOMEDICINAL PLANTS USED IN THE HEALTH CARE SYSTEM: SURVEY OF THE MID HILLS OF SOLAN DISTRICT, HIMACHAL PRADESH, INDIA.

Manoj Kumar, Radha, Himani Devi, Suraj Prakash, Sonia Rathore, Mamta Thakur, Sunil Puri, Ashok Pundir, Sneh P. Bangar, Sushil Changan, Tamilselvan Ilakiya, Mahesh K. Samota, Rahul D. Damale, Surinder Singh, Mukesh K. Berwal, Sangram Dhumal, Anilkumar G. Bhoite, Anshu Sharma, Marisennayya Senapathy, Bharat Bhushan, Vineet K. Maurya, Asha, Suman Natta, Ryszard Amarowicz, and Mohamed Mekhemar.

The study was performed in the mid hills of the Dharampur region in Solan district of Himachal Pradesh, India. At the study site, a total of 115 medicinal plants were documented (38 trees, 37 herbs, 34 shrubs, 5 climbers, 1 fern, and 1 grass). In the study region, extensive field surveys were performed between March 2020 and August 2021. Indigenous knowledge of wild medicinal plants was collected through questionnaires, discussions, and personal interviews during field trips. Plants with their correct nomenclature were arranged by botanical name, family, common name, habitat, parts used, routes used, and diseases treated. In the present study, the predominant family was Rosaceae, which represented the maximum number of plant species, 10, followed by Asteraceae and Lamiaceae, which represented 8 plant species. The rural inhabitants of the Dharampur region in the Solan district

have been using local plants for primary health care and the treatment of various diseases for a longer time. However, information related to the traditional knowledge of medicinal plants was not documented. The rural inhabitants of the Dharampur region reported that the new generation is not so interested in traditional knowledge of medicinal plants due to modernization in society, so there is an urgent need to document ethnomedicinal plants before such knowledge becomes inaccessible and extinct.

For further reading: https://doi.org/10.3390/plants10091842

MODELLING VADOSE ZONE FLOWS AND GROUNDWATER DYNAMICS OF ALLUVIAL AQUIFERS IN EASTERN GANGETIC PLAINS OF INDIA: EVALUATING THE EFFECTS OF AGRICULTURAL INTENSIFICATION

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Environmental Earth Sciences 80: 639

Groundwater-dependent agricultural intensification has led to unsustainability of groundwater systems in many parts of the world. The unconfined aquifers in the Eastern Indo-Gangetic Plains (EIGP) of India are one of the most extensive aquifer systems in South Asia and are prone to ever intensifying agricultural systems. This paper aims at evaluating the long-term impacts of agricultural intensification on groundwater dynamics in an agriculturally important sub-region of EIGP. The study proposes a multi-model approach, combining the capabilities of vadose zone model (HYDRUS-1D) and aquifer simulation model (MODFLOW) to analyse the recharge and discharge mechanisms in the alluvial Gangetic Plains. The study mathematically reconstructed the vadose zone and aquifer geometry and implemented them into flow models. We demonstrate that the loosely coupled vadose zone and groundwater flow modelling framework is highly suitable for simulating the impact of changed cropping intensity on groundwater dynamics. The recharge estimates from HYDRUS-1D and calibration of regional groundwater flow model offered a robust set of parameter values for the prevalent conditions of EIGP. The results show good correspondence between the observed and simulated water table levels during calibration, with RMSE = 0.56–0.59 m, NSE = 0.76–0.99 and R^2 = 0.83–0.91, all within acceptable limits. Projections showed that although the water table in the region would remain fairly stable under lower levels of cropping intensity (135–150%), further increase to 200 and 300% would lead to water table decline at the rate of 0.87 and 1.83 m per year, respectively. These changes could therefore impact future groundwater risk management in EIGP. This reinforces the view that groundwater-dependent intensification may be sustainable in long term only if adaptation strategies and compensatory measures are adopted.

For further reading: https://doi.org/10.1007/s12665-021-09915-w

ASSESSING GROUNDWATER STATUS AND HUMAN PERCEPTION IN DROUGHT-PRONE AREAS: A CASE OF BANKURA-I AND BANKURA-II BLOCKS, WEST BENGAL (INDIA)

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Environmental Earth Sciences 80: 636

Ground water is a precious natural resource in every aspect of human life from natural to artificial environment. Ground water is an indicator of regional development by improving the economic domain through intensive

agricultural practices, and aesthetic value through sufficient ground water supply as drinking water, fertile soil, and healthy vegetation. However, ground water availability and associated human perceptions were the main themes of the present study. In this study, both primary and secondary data were incorporated to understand the human adaptation behaviour in drought-prone areas of the fringe of Chhotanagpur plateau region (Bankura-I and II blocks) to ground water storage. GWPZ mapping is a very important exposure to knowing the ground reality. So, the MCDM-AHP method has been developed based on the eight dominant conditioning factors viz. geomorphology, lithology, lineament density, soil, drainage density, LULC, average slope, and slope aspect using GIS analytics with field expertise. The output result was validated with comparing 105 inventory stations where 0.850 AUC value was good for accepting the GWPZ model. As a result, a major portion of the study area is dominated by poor to moderate possibilities of ground water level (ground water level drops 1–2 m during the pre-monsoon) due to Proterozoic granite gneiss formation over the study area. With comparing demographic status, it was not favourable for a healthy lifestyle. Agriculture dominated rural environment of Bankura-I and II blocks is far away from the modern digital environment that is why ground water has played a very crucial role in the field of development. Moreover, to build up a good level of ground water recharge zone through rainfall harvesting, and sustainable land use planning will be the best management practices. So, availability of ground water should be a positive sign of development in the field of the economic sector and sustainable human society.

For further reading: https://doi.org/10.1007/s12665-021-09909-8

STAKEHOLDER PARTICIPATION IN PRIORITIZING SUSTAINABILITY ISSUES AT REGIONAL LEVEL USING ANALYTIC HIERARCHY PROCESS (AHP) TECHNIQUE: A CASE STUDY OF GOA, INDIA

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Environmental and Sustainability Indicators 11: 100116

This study involves stakeholders in prioritizing and ranking themes and sub-themes relevant to assess regional level sustainability. Three themes – social, economic and environment were identified as parent themes; to assess sustainability the key stakeholders identified 18 sub-themes to assess these three themes in detail. The key stakeholder groups of elected representatives (panchayats), government, industry and non-governmental organizations (NGOs)/academia, have been involved to assign weights to the themes and the sub-themes of the SDI, keeping the regional priorities in mind. Analytical Hierarchy Process (AHP), a decision-making technique has been used to prioritize and rank the various themes and sub-themes. Goa, one of the states of India, which has performed well on national level SDI developed as part of the earlier study (Kwatra et al., 2016), was taken as the case study to assess sustainability issues at regional level. It was found that all the stakeholder groups gave nearly equal importance to the three themes of sustainability – environment (38%), social (32%) and economic (30%), environmental theme was apparently given slightly higher weights. Among the sub-themes, livelihood received highest weight (11%), followed by waste management (8%), and environmental budget (8%). Issues like waste management, unemployment, forests and biodiversity, governance which are of local importance were given higher weights by the local stakeholders over the national level priority issues like climate change, air pollution, health and literacy etc. The study proposes and tests a methodology which can be applied at a regional scale to assess and prioritize key sustainability issues so that policy makers can take informed decisions.

For further reading: https://doi.org/10.1016/j.indic.2021.100116

EXTREME RAINFALL DEFICITS WERE NOT THE CAUSE OF RECURRING COLONIAL ERA FAMINES OF SOUTHERN INDIAN SEMI-ARID REGIONS

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Using information contained in the eighteenth to twentieth century British administrative documents, preserved in the National Archives of India (NAI), we present a 218-year (1729–1947 AD) record of socioeconomic disruptions and human impacts (famines) associated with 'rain failures' that affected the semi-arid regions (SARs) of southern India. By mapping the southern Indian famine record onto long-term spatiotemporal measures of regional rainfall variability, we demonstrate that the SARs of southern India repeatedly experienced famines when annual rainfall reduced by ~ one standard deviation (1 SD), or more, from long-term averages. In other words, 'rain failures' listed in the colonial documents as causes of extreme socioeconomic disruptions, food shortages and human distress (famines) in the southern Indian SARs were fluctuations in precipitation well within the normal range of regional rainfall variability and not extreme rainfall deficits (≥ 3 SD). Our study demonstrates that extreme climate events were not necessary conditions for extreme socioeconomic disruptions and human impacts rendered by the colonial era famines in peninsular India. Based on our findings, we suggest that climate change risk assessement should consider the potential impacts of more frequent low-level anomalies (e.g. 1 SD) in drought prone semi-arid regions.

For further reading: https://doi.org/10.1038/s41598-021-96826-2

REVEALING ALARMING CHANGES IN SPATIAL COVERAGE OF JOINT HOT AND WET EXTREMES ACROSS INDIA

Subhasmita Dash and Rajib Maity

Compared to any single hydroclimatic variable, joint extremes of multiple variables impact more heavily on the society and ecosystem. In this study, we developed new joint extreme indices (JEIs) using temperature and precipitation, and investigated its spatio-temporal variation with observed records across Indian mainland. Analysis shows an alarming rate of change in the spatial extent of some of the joint extreme phenomena, tending to remain above normal. For example, above normal *hot nights and wet days* events expands at a rate of 0.61% per year considering entire Indian mainland. If the historical trend continues at the same rate, consecutive *cold and wet day* events will drop below the threshold of mean value observed in the base line period (1981–2010) everywhere in the country by the end of the twenty-first century. In contrast, the entire country will be covered by *hot nights and wet days* events only (frequency of occurrence will cross the threshold of mean value observed in the base line period). This observation is also supported by the CMIP6 climate model outputs. It is further revealed that extremes of any single variable, i.e. either precipitation or temperature (e.g., Extreme Wet Days, Consecutive Wet Days, Hot Nights, and Cold Spell Duration Index), do not manifest such an alarming spatial expansion/contraction. This indicates that the consideration of the joint indices of hydroclimatic variables is more informative for the climate change impact analysis.

For further reading: https://doi.org/10.1038/s41598-021-97601-z

PREDICTING SUITABLE HABITATS OF *GINKGO BILOBA* L. FRUIT FORESTS IN CHINA

Lei Feng, Jiejie Sun, Tongli Wang, Xiangni Tian, Weifeng Wang, Jiahuan Guo, Huili Feng, Huanhuan Guo, Huihong Deng, and Guibin Wang

Ginkgo fruit can be used for food and medicine with high economic value. It is of great importance to ensure its sustainable production and genetic resource protection under climate change. In this study, niche models built with climate and soil variables, respectively, were used to assess the impact of climate change on its potential suitable habitat. The model performance was excellent for the climate model (AUC=0.92) and good for the soil model (AUC=0.84). Three climate variables (degree-days below zero, mean coldest month temperature, and mean annual precipitation) and two soil variables (subsoil cation exchange capacity and topsoil cation exchange capacity) were the main factors determining the distribution of ginkgo fruit forests. The level of predicted habitat suitability was consistent with the differences observed in fruit traits, suggesting that our model predictions make biological and economic sense. The high- and medium-suitable habitats of this species would decrease in future climates under both the Representative Concentration Pathway (RCP) 4.5 and RCP 8.5 climate change scenarios. This study contributed to a better understanding of the impact of climate change on ginkgo fruit forests and provided potential geographical areas for the cultivation and conservation of this species.

For further reading: https://doi.org/10.1016/j.crm.2021.100364

COUPLING COORDINATION RELATIONSHIP BETWEEN ECOSYSTEM SERVICES AND WATER-LAND RESOURCES FOR THE DAGUHE RIVER BASIN, CHINA

Baodi Sun, Jingchao Tang, Dehu Yu, and Zhiwen Song

Water and land resource utilization is an important driving force of changes in ecosystem services; therefore, research on multi-parameter coupling systems that consider "ecosystem services, water resources, and land resources" together has key significance for river basins. This study aims to reveal the interaction and mutual influence of ecosystem services and water and land resources in the Daguhe River Basin, China, based on the coupling coordination degree model. The results showed that during the period from 2000 to 2010, the coupling coordination degree values for the years 2000, 2005, and 2010 were 0.6005, 0.7292, and 0.8037. The corresponding coupling coordination classifications were categorized as "primary coordinated development", "intermediate coordinated development," and "well-coordinated development", respectively. These results reflected the fact that the relationship between water and land resource utilization and the environment tends to evolve in the direction of coordinated development (an improvement in one part corresponds to an improvement in another part) with variation in water and land utilization types, and eventually pushes the whole resource, as well as ecological and environmental systems, from low to high levels of coupling coordination degrees as observed in case of the Daguhe River Basin, China. Our research provides an overview of the interaction between

ecosystem services and water and land resources in the Daguhe Basin and even in the Shandong Province. With our results, we offer new perspectives on river basin management and for planning future eco-environmental policies (the policy is specifically designed for the ecological environment) by combining water and land resource utilization.

For further reading:

POLICY-DRIVEN CO-EVOLUTION OF THE FOOD–WATER–ECOSYSTEM–LIVELIHOOD NEXUS IN TWO ECOSYSTEM CONSERVATION HOTSPOTS IN SOUTHERN CHINA

Changwei Zhuang, Chong Jiang, Weilian Chen, Wumeng Huang, Ji Yang, Ying Zhao, and Zhiyuan Yang

Ecosystem restoration projects (ERPs) are effective for achieving sustainable development goals. However, a nexus perspective has not yet been effectively used to examine the regimes and interconnections between the sectors of agricultural production, ecosystem restoration, and the livelihoods of farmers, which may have constrained the efficacy of ERPs. In this study, the evolution of these different sectors in ecosystem restoration hotspot cases was investigated using a novel nexus perspective, and their interconnections and implications for ecosystem management were determined. Rapid urbanisation, reclamation, and ERPs have profoundly altered landscape patterns and caused significant ecological changes. Prior to 1999, extensive reclamation proved unsustainable because deforestation activities and cultivation on sloping cropland resulted in severe soil loss and ecosystem deterioration, despite providing significant increases in grain productivity and economic profits. Although revegetation practices after 1999 accelerated vegetation regeneration and enhanced soil retention and carbon sequestration, they also resulted in a decline in grain productivity and economic profits during the initial period of implementing ERPs (1999–2008). However, subsequent policy adjustments and the construction of terraced fields have mitigated cropland loss and maintained the grain supply. The nexus perspective was effective in identifying and coordinating relationships among the sectors, and timely policy interventions have transformed the relationships from trade-offs to synergies and provided win–win outcomes. However, the ongoing urbanisation continues to be a challenge for conserving ecosystems and ensuring food security; therefore, further optimised, and targeted strategies are required to balance contrasting goals and maximise co-benefits according to the environmental and socio-economic conditions.

For further reading:

ECO-ENVIRONMENTAL ASSESSMENT MODEL OF THE MINING AREA INGONGYI, CHINA

Ying Wang, Xueling Wu, Siyuan He, and Ruiqing Niu

The ecological environment directly affects human life. One of the ecological environmental issues that China is presently facing is deterioration of the ecological environment due to mining. The pollution produced by mining causes the destruction of land, water bodies, the atmosphere, and vegetation resources and new geological problems that seriously impact human civilization and life. The main purpose of this study is to present an environmental assessment model of mine pollution to evaluate the eco-environment of mining. This study added

mineral species and mining types into the factor layers and built an improved evaluation system to accurately evaluate the impact of mines on the eco-environment. In the non-mining area, the grades of the eco-environment were divided according to the Technical Criterion for Ecosystem Status Evaluation standard document. In the mining area, the grades of the assessment for the eco-environment were classified by a field survey. After comparing the accuracy of various methods, the support vector machine (SVM) model, with an accuracy of 94.8%, was chosen for the mining area, and the classification and regression tree (CART) model, with an accuracy of 89.36%, was chosen for the non-mining area. Finally, environmental assessment maps for the entire study area were generated. The results indicate that the mine environmental assessment system established by this study avoids the subjective limitations of traditional assessment methods, provides an effective method for assessing ecological quality, and will help relevant departments to plan for mine resources.

For further reading: https://doi.org/10.1038/s41598-021-96625-9

Pakistan- Himalaya

QUANTIFICATION OF POTENTIALLY TOXIC ELEMENTS IN DEGRADED MINING SOILS AND MEDICINAL PLANTS: A CASE STUDY OF INDUS KOHISTAN REGION NORTHERN PAKISTAN

Syed Wasim Sardar, Syed Aziz Ur Rehman, Javed Nawab, Sardar Khan, Abid Ali, Zia Ur Rahman, Shams Ali Baig, and Muhammad Qayash Khan

In recent years, a series of environmental and ecological problems have occurred due to enhanced anthropogenic disturbances for precious mineral mining. Traditional medicines have become an important pillar in national homeopathic treatment system, especially in mountainous environment of developing countries. The current study investigated the level of potentially toxic elements' (PTEs) contamination in degraded mining soils and medicinal plants along the mafic–ultramafic rocks in Kohistan region. Soil samples and medicinal plant species were collected from the degraded mining areas and screened for PTEs (Pb, Cr, Ni, Mn, Zn and Cd) using atomic absorption spectrometry (AAS-Perkin-Elmer, 2380). Various pollution indices were used for PTEs such as contamination factor (CF), pollution load index (PLI) and translocation factor (TF) in degraded mining soils and medicinal plants. The mean concentrations of selected PTEs in soil were in the order of Mn > Ni > Cr > Pb > Zn > Cd, while in medicinal plants the mean concentrations were in the following order: Pb > Cr > Mn > Ni > Zn > Cd. Highest bioaccumulation was observed in *Ajuga bracteosa* (Cr = 349 mg kg^{-1}), *Phlomis bracteosa* (Pb = 335 mg kg^{-1}), *Chenopodium ambrosioides* (Mn = 304.3 mg kg^{-1}), *Isatis costata* (Ni = 169 mg kg^{-1}), *Ajuga parviflora* (Zn = 38.4 mg kg^{-1}) and *Salvia moorcoftiana* (Cd = 11 mg kg^{-1}). Furthermore, the concentrations of PTEs were significantly higher ($p < 0.001$) in degraded mining soils and medicinal plants than the reference site, which may be attributed to the mining and open dumping of mining wastes. The present study reveals that chromite mining and open dumping of mining wastes can cause serious environmental problems in the study area. Furthermore, medicinal plants grown in degraded mining soils may pose risk to the local inhabitants as most of the people consume these plants for various health problems.

For further reading: https://doi.org/10.1007/s12665-021-09927-6