

Headlines Himalaya

July 15– July 30 (2020)

No. 611-612

Editorial Team: Binita Rimal and Sweccha Raut

For the 611th-612th issues of Headlines Himalaya, we reviewed journal articles from seven sources and selected twelve researches from five countries. We selected one research from Nepal and eleven researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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WHAT DETERMINES INDIGENOUS *CHEPANG* FARMERS' SWIDDEN LAND-USE DECISIONS IN THE CENTRAL HILL DISTRICTS OF NEPAL?

Sharif A. Mukul and Anja Byg

Sustainability 12: 5326

Swidden or shifting cultivation is a widespread yet controversial land-use in the tropical forest–agriculture frontier. In recent years, the extent of land under swidden and the people who rely on it for subsistence and income have declined. We report swidden land-use changes in two central hill districts of Nepal by indigenous *Chepang* communities—a stronghold of swidden cultivation in mountainous Nepal. Despite a common trend of swidden decline, as in other parts of South and Southeast Asia, we found that swidden is important in the life and livelihoods of smallholder rural *Chepang* farmers in the area. Swidden cultivation was found to be more important to farmers with limited off-farm opportunities and in areas where alternative land-uses were scarce. We discuss biophysical, socio-economic, institutional, and other key drivers affecting farmers' decision to shift away from or continue with swidden in the area. Using linear mixed effect models, we also examined households' attributes that may expedite swidden decisions in the area. Our study recommends greater access to alternative land-use(s) and other income-generating options for the wellbeing of smallholder indigenous *Chepang* farmers, as well as the sustainability of this age-old land-use practice.

For Further Reading: <https://doi.org/10.3390/su12135326>

CAN STRATOSPHERIC GEOENGINEERING ALLEVIATE GLOBAL WARMING-INDUCED CHANGES IN DECIDUOUS FRUIT CULTIVATION? THE CASE OF HIMACHAL PRADESH (INDIA)

Jyoti Singh, Sandeep Sahany, and Alan Robock

Climatic Change 160: 1-21

Using Hadley Global Environment Model 2 - Earth System and Max Planck Institute Earth System Model simulations, we assess the impact of global warming and stratospheric geoengineering on deciduous fruit production in Himachal Pradesh (the second-largest apple-producing state in India). The impacts have been assessed for the Representative Concentration Pathways 4.5 (RCP4.5) global warming scenario, and a corresponding geoengineered scenario (G3) from the Geoengineering Model Intercomparison Project, in which stratospheric aerosols are increased for 50 years from 2020 through 2069 to balance the global warming radiative forcing, and then aerosol precursor emissions are terminated. We used the period 2055–2069 (with the largest geoengineering forcing) and the period 2075–2089 (beginning 5 years into the termination phase) and evaluated winter chill and growing season heat accumulation. We found that although stratospheric geoengineering would be able to suppress the increase in temperature under an RCP4.5 scenario to some extent during both switch-on and switch-off periods, if the geoengineering was terminated, the rate of temperature increase would be higher than RCP4.5. The agroclimatically suitable area is projected to shift northeastwards (to higher elevations) under RCP4.5 as well as G3 during both periods. However, during the switched-on period, geoengineering would restrict the shift, and areas of Shimla and Mandi districts (most suitable under the current climate) would not be lost due to global warming. Even during the switched off period, before the climate returned to RCP4.5 levels, the above areas would, although to a lesser extent, have reduced harmful climate effects from global warming. However, the area of suitable land (the intersection of soil and agroclimatic suitability) would decrease in both periods for RCP4.5 as well as G3, because as more high-elevation regions become agroclimatically suitable, they do not have suitable soils to support cultivation. Geoengineering could benefit deciduous fruit production by reducing the intensity of global warming; however, if geoengineering was terminated abruptly, the rate of change in temperature would be quite high. This could lead to a rapid change in land suitability and might result in total crop failure in a shorter period compared to RCP4.5.

For Further Reading: <https://link.springer.com/article/10.1007/s10584-020-02786-3>

PERFORMANCE EVALUATION OF PARKING INTEGRATED GRID-CONNECTED PHOTOVOLTAIC SYSTEM LOCATED IN NORTHERN INDIA

Rachit Srivastava, A.N. Tiwari, and V.K. Giri

Environment, Development and Sustainability 22: 1-20

In the recent years, small-scale grid-connected photovoltaic (PV) plants got attention from institutions and organizations. In this series, a parking integrated grid-connected PV system has been installed in the university situated in the northern region of India. The plant consists of some partially shaded PV modules. In the literature, the shading effect has not been analyzed yet in the performance evaluation of the PV plant. In this study, performance evaluation has been carried out based on the International Electro-technical Commission 61724 standard considering shading effect. An adequate number of software are available for estimation of the plant, but among them PVsyst and PV*SOL software have the feature to observe shading effect on the plant by creating an actual three-dimensional environment of the plant in the software. Hence, the results of the actual plant have been compared with those obtained from this two software. In this study, technical and financial analysis has also been carried out. Through the performance evaluation, it has been found that the specific annual final energy production of the PV plant is 988.9 kWh/kW, the payback period of the plant is almost 17 years, and the annual loss of production due to shading effect has been evaluated as about 16%. From these results, it can be concluded that the plant is demonstrating considerably good performance even while facing shading in parking integrated grid-connected PV system and is technically/economically feasible for electricity generation in northern India without taking extra space. This study would be helpful in designing of small-scale PV plant in an institution or organization in the areas even where partial shading is also present. This study would also be helpful in the development of large-scale parking integrated grid-connected PV systems.

For further reading: <https://doi.org/10.1007/s10668-020-00845-4>

RESPONSE OF STREAMFLOW TO CLIMATE VARIABILITY IN THE SOURCE REGION OF JHELMUM RIVER BASIN IN KASHMIR VALLEY, INDIA

Mifta ul Shafiq, Ifra Ashraf, Zahoor ul Islam, Pervez Ahmed, and A.P. Dimri

Natural Hazards 102: 1-27

Successful management of the water resources directly depends on our understanding of the heterogeneity of changing climate and consequent response of annual and seasonal stream flows in different climatic regions. This study was undertaken to quantify the spatial and temporal variability of different climatic variables and their subsequent impacts on streamflow's of river Jhelum and its tributaries during last more than three decades. Mann–Kendall trend statistic and Sen's slope estimator test were used for assessing the trends and variability in climatic and streamflow variables. Data obtained from 11 hydrometric and 6 meteorological stations for different time intervals were used for analysis. The results pointed toward various significant trends in both hydrological and meteorological stations. Kashmir Himalayas witnessed rise in mean maximum temperature (+0.05 °C/year) and mean minimum temperature (+0.01 °C/year) with substantial reduction in precipitation (–4.2 mm/year) from 1980 to 2015. Analysis of the streamflow trends revealed significant decreasing trends in all the hydrometric stations with the highest decrease in spring and summer seasons. Furthermore, the correlation analysis revealed a significant negative correlation between increase in temperature and streamflow, while strong positive correlation was realized with precipitation at both annual and seasonal scales.

For further reading: <https://doi.org/10.1007/s11069-020-04183-6>

INVESTIGATING THE EFFECTS OF GREENHOUSE VEGETABLE CULTIVATION ON SOIL FERTILITY IN LHASA, TIBETAN PLATEAU

Zhaofeng wang, Dianqing Gong, and Yili Zhang

Chinese Geographical Science 30: 456-465

The area of land utilized for growing vegetables in greenhouses has expanded rapidly on the Tibetan Plateau over recent decades. However, the effects of greenhouses on soil fertility as well as variations in these effects between the plateau and plain remain unclear on the Tibetan Plateau. This study assessed the effects of vegetable greenhouses in the vicinity of Lhasa, using open field soil as a control. A total of 92 plough layer (0–20 cm depth) soil samples including 54 from greenhouses and 38 from open fields were taken, and soil pH, electrical conductivity (EC), total soluble salt (TS), soil organic matter (SOM), total nitrogen (TN), available phosphorus (AP), and available potassium (AK) were measured. The results reveal that, soil pH was lower 1.0 units in greenhouses than that in open field. TS was higher 82% and AP was higher 160% overall. Similarly, SOM and TN were higher 32% and 46%, respectively, while AK changed slightly at a higher 1% rate. Results also show that soil properties varied depending on cultivation time and vegetable types. Overall, pH continuously decreased with cultivation time while other soil fertility indicators reached a maximum value after nine years of cultivation before starting to decrease. The effect of leafy vegetable planting on soil was slight overall, while the impact of fruits on soil was more serious. Compared with changes in plain greenhouse soil fertility measured across the eastern China, the effects of greenhouses on soil in Lhasa remain relatively limited; and the change in the degree of soil fertility was lower and the extreme values of soil fertility occurred later in Lhasa.

For further reading: <https://doi.org/10.1007/s11769-020-1118-z>

SPATIO-TEMPORAL VARIATIONS AND COUPLING OF HUMAN ACTIVITY INTENSITY AND ECOSYSTEM SERVICES BASED ON THE FOUR-QUADRANT MODEL ON THE QINGHAI-TIBET PLATEAU

Sun Yongxiu, Liu Shiliang, Shi Fangning, An Yi, Li Mangqi, and Liu Yixuan

Science of the Total Environment 743: 140721

Human activities have an impact on the structure and function of ecosystems, which in turn affects ecosystem service (ES) supply and demand. Based on the four-quadrant model of human activities and ecosystem services, this study evaluated the ecological quality at the county scale on the Qinghai-Tibet Plateau (QTP). Results showed: (1) Human activity intensity (HAI) showed great spatio-temporal variations across the QTP. The mean HAI was low overall and increased by 4% during 2000–2015. HAI in more than 13% of the area of the QTP showed an increasing trend and high HAI levels were mainly distributed in the eastern and central parts. A low HAI level occupied the majority of the study area and declined during the period. (2) The mean ES balance declined during the period and exhibited great spatial variations, with the higher ES balance mainly distributed in the mid-eastern cities of the QTP. The ES balance in approximately 68% of the cities decreased, indicating the ESs were in degradation, with demand exceeding supply. (3) Approximately 98% of the study area, including 205 counties, was in the first, second and fourth quadrant, and only 2% was in the third quadrant, indicating that ecological quality became better overall on the QTP. During 2000–2015, 87.14% of counties were nearly unchangeable—these were distributed in the most regions of the QTP, and only 9.79% and 3.08% of counties were improving and degrading, respectively, mainly distributed in the mid-eastern regions. The change implied that the ecosystems were basically in a stable state and the environment greatly improved on the QTP from 2000 to 2015. This study contributes to exploring the effect of human activity on ecosystem service, thereby providing credible guidance for regional ecosystem management.

For further reading: <https://doi.org/10.1016/j.scitotenv.2020.140721>

HITCHHIKING TRAVEL IN CHINA: GENDER, AGENCY AND VULNERABILITY

Xiongbin Gao, Scott Cohen, and Paul Hanna

Annals of Tourism Research 84: 103002

Despite its recent emergence as an alternative way of travel, hitchhiking in China remains significantly understudied, with its gender aspects unexplored. Investigating the (re)constitution of gendered Chinese hitchhiking subjects in contemporary China, this paper rethinks the paradox of agency largely unexamined in tourism gender research. Ethnographic fieldwork was conducted on the South Sichuan – Tibet Route. The findings demonstrate that gendered subjectivities of the vulnerable female and the invulnerable male in hitchhiking are produced by normative heterosexuality and the principle of reciprocity as interrelated discursive regimes. The paper contributes an understanding of resistance as a contested site that accommodates ongoing political debates and ethical reflections, which requires agency to be continuously posed as a question rather than a solution.

For further reading: <https://doi.org/10.1016/j.annals.2020.103002>

Bhutan-Himalaya

WEEDS IN THE LAND OF GROSS NATIONAL HAPPINESS: KNOWING WHAT TO MANAGE BY CREATING A BASELINE ALIEN PLANT INVENTORY FOR BHUTAN

Dorjee, Stephen Barry Johnson, Anthony John Buckmaster, and Paul Owen Downey

Biological Invasions 22: 1-16

Biological invasions are a serious threat globally, but particularly in developing countries. Bhutan is unique among South Asian countries in that it has a rich biodiversity, and its people have a 'sacred' responsibility to protect the environment and native biodiversity; conversely it is also considered a 'crisis ecoregion' because of significant threats to biodiversity from anthropocentric activities. Managing biological invasions is difficult without a comprehensive baseline of the alien species present. An alien plant inventory for Bhutan was created by examining an extensive array of information and data sources such as herbaria records, published floras, unpublished documents, and from personal communications. The alien plant flora including cultivated taxa in Bhutan comprises 139 families, 545 genera and 964 species. Of these, 626 species occur only in cultivation, whilst the other 338 species occur in the wild (spontaneous); 131 (39%) casuals, 103 (31%) naturalised and 101 (30%) invasive. The major of naturalised alien plants were introduced as pasture species (32%), ornamentals (24%) and from unintentional sources (22%). Whilst, the major of invasive species were introduced unintentionally (76%), as ornamentals (15%) and pasture species (3%). Because a large proportion of alien plants have been deliberately introduced, implementation of both pre-border weed risk assessment and post-border weed risk management approaches can be effective in Bhutan, despite the country's open and porous borders. Such a biosecurity approach could also be implemented on a plant import sector basis, as only four sectors account for 86% of alien plant introductions, largely through one entry point. The baseline inventory and analysis will shape future management and policy directions for alien plants in Bhutan.

For further reading: <https://doi.org/10.1007/s10530-020-02306-5>

WETLAND PLANT COMMUNITIES OF THE EASTERN HIMALAYAN HIGHLANDS IN NORTHERN BHUTAN

Pema Tendar, David J. Cooper, and Kitichate Sridith

Wetlands 40: 1-12

The study was conducted to characterize previously unexplored wetland vegetation in lower montane areas of the Himalaya (1597–2538 m above sea level) of Jigme Dorji National Park, Gasa District, Northern Bhutan. A random quadrat sampling method was employed to assess percent plant cover and environmental data were collected

following standard procedures. Cluster and indicator species analyses using plant cover data were used to define the species composition of plant communities. Differences in community composition along gradients of elevation, slope, soil pH, available phosphorus, and peat/soil depth were analyzed using Canonical Correspondence Analysis (CCA). The wetlands supported 120 vascular plant species from 84 genera and 51 families. Analyses identified four plant communities, I to IV, each named from the three most prominent species. The key indicator species of four plant communities, *Acorus calamus*, *Carex diandra*, *Equisetum ramosissimum*, and *Carex capillacea*, dominate shallow fresh marsh, seasonally flooded basin of flat, fresh water meadow, and poor fen, respectively. Elevation and soil phosphorus were the most important environmental variables in explaining the variation in wetland vegetation. The findings can be used to support the work of conservation agencies to identify and conserve these plant communities and their habitats in the Himalaya.

For further reading: <https://doi.org/10.1007/s13157-020-01339-9>

HERDERS AND LIVESTOCK PROFESSIONALS' EXPERIENCES AND PERCEPTIONS ON DEVELOPMENTS AND CHALLENGES IN YAK FARMING IN BHUTAN

Nedup Dorji, Marjolein Derks, Phub Dorji, Peter W. G. Groot Koerkamp and Eddie A. M. Bokkers

Animal Production Science 60

The yak-based transhumant system is influenced by socioeconomic developments, regulations and environmental changes. Little is known about the impact of this on yak farming practices among different regions in Bhutan. The experienced changes in yak farming practices over the years and perceptions on developments were assessed through interviews with yak herders in three regions (west, $n = 22$; central, $n = 20$; east, $n = 25$) and with livestock extensionists ($n = 28$). At present, forage shortage in the rangeland, yak mortality mainly due to (endangered) wild predators and, to a lesser extent, labour availability are the main concerns in all yak farming regions. These concerns have increased due to socioeconomic developments (e.g. education and other sources of income) and strong conservation policy, which affects the living environment of the yaks. Overall, the market to sell yak products and livestock extension services has improved, but forage shortage and yak mortality has increased over the years. However, some factors causing forage shortage are more specific to certain regions, e.g. competition with the horse population (west), cattle and cattle–yak hybrids (east), cordyceps collection (west and central) and prohibited burning of rangelands (central and east). Family labour available to herd yaks has slightly decreased, and the number of young family members (successors) to take over yak farming has decreased over the years. On the basis of the experiences and perceptions of yak herders and extensionists, we conclude that increasing forage shortage in the rangelands, decreasing numbers of successors, and increasing yak predation by wild animals are the major threats to yak farming. This study demonstrates that yak farming in Bhutan experiences an increasing pressure to sustain. Differences between regions make clear that a one blanket-policy will not be effective to preserve yak farming for the future.

For further reading: <https://doi.org/10.1071/AN19090>

Pakistan- Himalaya

SOCIAL ACCEPTABILITY OF SOLAR PHOTOVOLTAIC SYSTEM IN PAKISTAN: KEY DETERMINANTS AND POLICY IMPLICATIONS

Inayatullah Jan, Waheed Ullah, and Muhammad Ashfaq

Journal of Cleaner Production 274: 123140

Solar energy is abundantly available in Pakistan and is converted into electrical energy by using solar photovoltaic system. This study identifies the determinants of social acceptability of solar photovoltaic (PV) system in northwest Pakistan. The study is based on a survey of 100 randomly selected households from three villages in Khyber Pakhtunkhwa, Pakistan. In the study area, 46% of the households used solar PV system. We used binary logistic model to investigate the determinants of social acceptability of solar PV system. The results show that income of the household, household's monthly cost of energy consumption, education of respondents, information about the availability of solar PV system in the market, and source of awareness about solar PV system are the key determinants of the social acceptability of solar PV system. The overall model was highly significant as shown by $p < 0.001$. The study

concludes that household, community, and market related variables play a key role in the social acceptability of solar PV system. The study recommends that the government should adopt incentive-based policies that focus on solar energy promotion in Pakistan.

For further reading: <https://doi.org/10.1016/j.jclepro.2020.123140>

BACILLUS SIAMENSIS REDUCES CADMIUM ACCUMULATION AND IMPROVES GROWTH AND ANTIOXIDANT DEFENSE SYSTEM IN TWO WHEAT (*TRITICUM AESTIVUM* L.) VARIETIES

Samrah Afzal Awan, Noshin Ilyas, Imran Khan, Muhammad Ali Raza, Abd Ur Rehman, Muhammad Rizwan, Anshu Rastogi, Rezwan Tariq, and Marian Brestic

Plants 9: 878

Bioavailability of cadmium (Cd) metal in the soils due to the scarcity of good quality water and industrial waste could be the major limiting factor for the growth and yield of crops. Therefore, there is a need for a prompt solution to the Cd toxicity, to fulfill increasing food demand resulting from growing world population. Today, a variable range of plant growth promoting rhizobacteria (PGPR) is being used at a large scale in agriculture, to reduce the risk of abiotic stresses on plants and increase crop productivity. The objective of this study was to evaluate the efficacy of *Bacillus siamensis* in relieving the Cd induced damage in two wheat varieties (i.e., NARC-2009 and NARC-2011) grown in Cd spiked soil at different concentrations (0, 20, 30, 50 mg/kg). The plants under Cd stress accumulated more Cd in the roots and shoots, resulting in severe oxidative stress, evident by an increase in malondialdehyde (MDA) content. Moreover, a decrease in cell osmotic status, and alteration in antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and ascorbate peroxidase (APX) were also observed in wheat plants under Cd stress. As a result, the Cd exposed plants showed a reduction in growth, tissue biomass, photosynthetic pigments, membrane stability, total soluble sugars, and amino acids, in comparison to control plants. The extent of damage was observed to be higher with an increase in Cd concentration. However, the inoculation of wheat with *B. siamensis* improved plant growth, reduced oxidative stress, and enhanced the activities of antioxidant enzymes in both wheat varieties. *B. siamensis* amendment brought a considerable improvement in every parameter determined with respect to Cd stress. The response of both wheat varieties on exposure to *B. siamensis* was positively enhanced, whereas NARC-2009 accumulated less Cd compared to NARC-2011, which indicated a higher tolerance to Cd stress mediated by *B. siamensis* inoculation. Overall, the *B. siamensis* reduced the Cd toxicity in wheat plants through the augmentation of the antioxidant defense system and sugars production.

For further reading: <https://doi.org/10.3390/plants9070878>