**An Environmental Research Abstract**

# Headlines Himalaya

For the 673th - 674th issues of Headlines Himalaya, we reviewed researches from nine sources and selected 18 researches from five countries. We selected four researches from Nepal and 14 researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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## Nepal-Himalaya

### POTENTIAL IMPACTS OF CLIMATE CHANGE AND ADAPTATION IN AGRICULTURE ON POVERTY: THE CASE OF NEPAL

Sudarshan Chalise and Athula Naran panawab

*Journal of the Asia Pacific Economy* 26: 1-20

The main theme of this paper is to investigate the socio-economic impacts of climate change and adaptation; by comparing the losses with and without land reallocation for major staple foods as a key strategy of climate change adaptation in the farming system. In doing so, a computable general equilibrium (CGE) model for Nepal has been developed, incorporating the allocation of land for several agricultural crops, including the major staple foods, with specification of a nested set of constant elasticity of transformation (CET) functional forms. The set of land transformation elasticities facilitates switching from one crop to another; based on their agronomic characteristics and degree of climate change impacts. Using Global Trade Analysis Project (GTAP) data and Living Standard Survey (LSS) data, a social accounting matrix (SAM) for Nepal is developed and used to simulate three scenarios of climate change and land reallocation. The simulation results in the long run depict farmers as more likely to use land for crops that are comparatively less impacted by climate change, such as paddy. The results further show that land reallocation reduces the income inequality and poverty among rural and urban households by significantly controlling the income losses of marginal farmers.

For further readings: https://doi.org/10.1080/13547860.2021.1982194

## APPLYING THE DOUBLE OBSERVER METHODOLOGY FOR ASSESSING BLUE SHEEP POPULATION SIZE IN NAR PHU VALLEY, ANNAPURNA CONSERVATION AREA, NEPAL

Kamal Thapa, Rodney Jackson, Lalu Gurung, Hari Bhadra Acharya, and Raj Kumar Gurung

This study was undertaken in spring, 2019 to assess the applicability of the double-observer survey method for estimating blue sheep *Pseudois nayaur* abundance in Nar-Phu valley of Manang District located in Annapurna Conservation Area of northern Nepal. Since counting large mammals in rugged mountain habitat poses a special challenge, we tested the efficacy of the double observer method for generating robust population estimates for this important protected area. The overall detection probability for observers (O1 and O2) was 0.94 and 0.91 for a total of 106 groups comprised of 2059 individual blue sheep. We estimated the area's blue sheep population at 2070 (SE ± 168.77; 95% CI 2059–2405) for the 246.2 km$^2$ of sampled habitat. We determined blue sheep to be widely distributed within the study area with a mean density of 8.4 individuals per km2 based on a total study area of 246.2 km$^2$. We discuss demographic population structure and identify limitations when applying the double observer approach, along with recommending viewshed mapping for ensuring more robust density estimates of mountain-dwelling ungulates like blue sheep or ibex that inhabit extremely heterogeneous terrain which strongly influences sighting distances and overall animal detection rates.

For further reading: https://doi.org/10.2981/wlb.00877

## HABITAT USE AND CONSERVATION THREATS TO WILD WATER BUFFALO *BUBALUS ARNEE* (MAMMALIA: ARTIODACTYLA: BOVIDAE) IN KOSHI TAPPU WILDLIFE RESERVE, NEPAL

Reeta Khulal, Bijaya Neupane, Bijaya Dhami, Siddhartha Regmi, Ganesh Prasad Tiwari, and Manita Parajuli

Wild Water Buffalo (WWB) *Bubalus arnee* is an endangered species and a protected animal in Nepal. The remaining WWB population is located in Koshi Tappu Wildlife Reserve (KTWR), and it appears to have low viability under prevailing conditions. We assessed the habitat use and conservation threats to wild water buffalo in KTWR. For habitat analysis the quadrant method was used. Eighty-four quadrants of 25 m2 for trees, 168 quadrants of 10m2 for shrubs and 336 quadrants of 1 m2 for herbs were laid out in the study area. Ivlev's electivity index (IV) was calculated to assess the use of different habitat components. The important Value Index (IVI) was used for vegetation assessment. A relative threat ranking method was used to assess conservation threats for wild buffalo and their habitats. Wild buffalo mostly preferred habitats with distance to water resources less than 500 m (IV= 0.4), less than 25 % crown coverage (IV= 0.39) and more than 75 % ground coverage (IV= 0.42).The trees species *Phyllanthus emblica*, *Acacia catechu*, shrub species *Mimosa pudica* and the herb species *Brachiaria distachya, Vetiveria zizanioides, Imperata cylindrica,* and *Saccharum spontaneum* were preferred by WWB in the study area. Among the different plant categories, we found that *Acacia catechu* was the most preferred tree species (IVI= 156.95), *Mimosa pudica* the most preferred shrub species (IVI= 58.68), and *Imperata cylindrica* the most preferred herb species (IVI= 64.73). Major conservation threats perceived by local stakeholders for wild buffaloes were overgrazing by cattle and genetic swamping through crossbreeding with domestic buffalo. Therefore, conservation of grass species through control of grazing, and prevention of cross breeding are measures supported by this

study. Additionally, site-specific conservation strategies should be adopted based on identified threats in the study area.

For further reading:

**DIVERSITY OF AGROFORESTRY SPECIES AND USES IN TWO ECOLOGICAL REGIONS: A CASE FROM CENTRAL NEPAL**

Hari Prasad Pandey, Narayan Prasad Pokhrel, Dol Raj Luitel, Kamal Acharya, and Kabita Kumari Shah

Multiple benefits of the agroforestry systems attract the attention of the global community and are being practiced in Nepal from time immemorial. However, there is minimal evidence of the diversity of species and the use value of plants and their comparative analysis in ecological regions. *is study compares the diversity and use value of plants grown in the agroforestry system (home garden) in two separate ecological regions in central Nepal. *e frequently used diversity indices were used to measure species diversity. A total of 130 and 99 species, 96 and 69 genera, and 50 and 40 families were reported from home gardens in the Terai and midhill ecological regions, respectively, where 58 species were common for both. *e findings reveal Terai farmer prefers ornamental plants over fruit and fodder in the midhills indicating that horticulture and livestock-based livelihood could be enhanced in the hilly region. *e diversity indices indicate a higher diversity of plants in the Terai region than in midhills. However, Mann–Whitney *U* test showed an insignificant difference in species diversity between the regions. Moreover, the chisquare test revealed that there is no significant variation in the use diversity for the regions. *e results demonstrate similar plant diversity in the home garden despite the difference in ecological regions and species varieties. *e finding assists in understanding the composition of biodiversity in agroforestry systems in specific areas of two different ecological zones and provides insight into the agroforestry for species preferences and use-related decisions. Future research with established management procedures may be required to confirm these findings and provide agroforestry establishment criteria for agricultural sustainability.

For further readings:

## India-Himalaya

**ION CHEMISTRY AND QUALITY ASSESSMENT OF A POST-GLACIAL SACRED LAKE IN SIKKIM HIMALAYA: SOURCE IDENTIFICATION AND CONSERVATION MEASURES**

Nilabhra Auddy, Krishnendu Kumar Pobi, Sreetanwi Chakraborty, and Sumanta Nayek

The present research work aims to investigate the seasonal variations in hydrochemistry and water quality of Khacheopalri Lake, a recognized Ramsar site in Sikkim Himalayas, along with determining the dissolved ion sources and the mechanisms influencing lake water chemistry. The result has shown the acidic nature of lake water with distinct seasonal variation (mean pH 5.61 and 6.02 in the dry and wet seasons). Elevated values for EC, TDS, DO, $HCO_3^-$, $Cl^-$ in the lake water during the wet season are due to the precipitation, dissolution, and diffusion of $O_2/CO_2$ in the lake system. The hydrochemical facies of lake water is of $Ca^{2+}$–$HCO_3^-$ type, depicts dominance of

$Ca^{2+}$ and $HCO_3^-$ in ionic composition. Cross plot analyses elucidate that lake water chemistry is majorly governed by bicarbonate weathering, with minor contributions from silicate weathering. Principal component analysis of hydrochemical dataset has confirmed that major cations and anions in lake water have mainly arrived from geogenic sources as a result of weathering and erosion in the lake catchment area. However, run-off water from adjacent croplands, human settlements, and temporal factors also contributed to determining lake water characteristics. Evaluation of water quality index (WQI) has ascertained that the lake water is "good to excellent" in type and pertinent to aquatic life and human uses. The findings from present study can provide essential baseline information which would be crucial for effective management and conservation of this sacred ecological site and can be a good reference for further study on glacial-formed Lesser Himalayan lakes.

For further reading: https://doi.org/10.1007/s42108-021-00155-z

## DEVELOPING A PROTOTYPE LANDSLIDE EARLY WARNING SYSTEM FOR DARJEELING HIMALAYAS USING SIGMA MODEL AND REAL-TIME FIELD MONITORING

Minu T. Abraham, Neelima Satyam, Biswajeet Pradhan, Samuele Segoni, and Abdullah Alamri

Rainfall thresholds are commonly utilized to forecast landslides using the historical relationship between occurrence of slope failures and rainfall in an area. SIGMA (Sistema Integrato Gestione Monitoraggion Allerta) is a rainfall threshold model, which uses the statistical distribution of rainfall for forecasting the occurrence of landslides. The threshold curves are functions of standard deviation of the cumulated rainfall data, taking into account both long-term and short term-rainfall. To overcome the limitations of statistical rainfall threshold, the real-time monitoring data from MicroElectroMechanical Systems (MEMS) tilt sensors have been integrated with SIGMA model using a decisional algorithm for a test site (Kalimpong) in Darjeeling Himalayas, in the northeastern part of India. Three different models, the SIGMA model, tilt meter readings and the combination of both are compared quantitatively using the precipitation and landslide data of Kalimpong town between July 2017 and September 2020. The results indicate that the integration of tilt meter readings has lowered the number of false alarms issued by SIGMA model from 70 to 38 in the studied period, with an increase in the likelihood ratio from 18.10 to 20.23. The Receiver Operating Characteristic (ROC) curves indicate that the combined approach has the best performance among the models considered in this study, with an area under the curve 0.976. The proposed method was found to have better performance than the other rainfall thresholds derived for Kalimpong region so far, and the prototypal model can be further fine-tuned to develop an operational Landslide Early Warning System (LEWS) for the region.

For further reading: https://doi.org/10.1007/s12303-021-0026-2

## PHYCOREMEDIATION OF WATER OF *ELLENGA BEEL* POLLUTED WITH PAPER MILL EFFLUENT USING *CHLORELLA ELLIPSOIDEA* AND *DESMODESMUS OPOLIENSIS*

Abhinav Sharma, Susmita Das, Ajitabh Bora, Subham C. Mondal, Nirmali Gogoi, and Sanjai K Dwivedi

The present study investigated the phycoremediation efficacy of two freshwater green microalgae *Chlorella ellipsoidea* and *Desmodesmus opoliensis* for treatment of water of *Ellenga beel*, a wetland located in the vicinity of

Nagaon paper mill and into which effluents of the paper mill are drained-off. After inoculation of water samples with the two freshwater green microalgae, the culture medium were analyzed for various physicochemical parameters such as pH, electrical conductivity, total dissolved solids, phosphate, nitrate, potassium, chloride, phenol, cyanide, biological oxygen demand, chemical oxygen demand and heavy metals at every seven days interval for a period of 42 days. A reduction of phosphate (85%), sulfate (96%), nitrate (76%) and chloride (48%) was observed after 42 days of incubation in the tested beel water. The micro algal incubation also resulted in decrease of heavy metal such as Pb (54%), Zn (98%), Cr (59%), and Cu (61%). Comparison of Fourier transform infrared spectra of beel water samples (control) with those inoculated with the test micro algal species showed presence of binding sites for certain functional groups like phosphate, amide, carbohydrate and alkyl halides in inoculated samples. *D. opoliensis* exhibited higher phycoremediation efficiency than *C. ellipsoidea* in removal of pollutants from the beel water samples.

For further reading: https://doi.org/10.1080/10889868.2021.1990209

## SPATIOTEMPORAL DYNAMICS OF GLACIAL LAKES (1990–2018) IN THE KASHMIR HIMALAYAS, INDIA USING REMOTE SENSING AND GIS

Rayees Ahmed, Gowhar Farooq Wani, Syed Towseef Ahmad, Riyaz Ahmad Mir, Mansour Almazroui, Sanjay K. Jain, and Pervez Ahmed

This study is perhaps the first attempt to use satellite data (1990–2018) to analyze spatiotemporal changes in glacial lakes over the Kashmir Himalayas supplemented by field studies. Landsat images were used to delineate the spatial extent of glacial lakes at four-time points, i.e., 1990, 2000, 2010 and 2018. The total count of lakes as well as their spatial extent showed a discernible increase. The number increased from 253 in 1990 to 324 in 2018, with a growth rate of 21.4%. The area has increased from $18.84 \pm 0.1$ km$^2$ in 1990 to $22.13 \pm 0.12$ km$^2$ in 2018 with a growth rate of 14.7%. The newly formed glacial lakes, including supraglacial lakes, were greater in number than the lakes that disappeared over the study period. All glacial lakes are situated at elevations of 2700 m asl and 4500 m asl. More than 78% of lake expansion in the study region is largely due to the growth of existing glacial lakes. Through area change analysis, our findings reveal that certain lakes show rapid expansion needing immediate monitoring and observation. The analysis of the meteorological variables reveals that minimum and maximum temperatures in the Jhelum basin have shown an increasing trend. $T_{max}$ showed an increase of 1.25 °C, whereas $T_{min}$ increased to 0.7 °C from 1980 to 2020. On the other hand, precipitation has shown a decreasing trend, which can be attributed to one of the major causes of glacier recession and the expansion of glacial lakes in the Upper Jhelum basin. Consequently, this study could play a significant role in devising a comprehensive risk assessment plan for potential Glacial Lake Outburst Floods (GLOFs) and developing a mechanism for continuous monitoring and management of lakes in the study region.

For further reading: https://doi.org/10.1007/s43832-021-00007-1

## China Himalaya

## LOCKING EFFECT OF GRANODIORITE PORPHYRY VEINS ON THE DEFORMATION OF BAIGE LANDSLIDE (EASTERN TIBETAN PLATEAU, TIBET)

Peng Cao, Zhong Chen, Shitao Zhang, Yingshu Li, Zongliang Li, and Renji Ba

In 2018, two high-position and large-scale landslides occurred in Baige village, Jiangda County, Tibet. At present, both sides of the landslide are still in a process of continuous deformation. Deformation trend and mechanism are key to developing a landslide disaster reduction and next-step prevention plan. Based on geological surveys, magnetotelluric sounding, oblique photogrammetry, polarizing microscopy, and Global Navigation Satellite System, this paper analyzes and studies the residual deformation bodies (K3 and K2) of the Baige landslide in combination with regional geological data. The results indicated the following: (1) The maximum horizontal displacement of the monitoring point in the K2 area was 1217 mm, with maximum vertical displacement of 895.5 mm, while maximum horizontal displacement of K3 area was 622.2 mm, with maximum vertical displacement of 392.1 mm. Both horizontal and vertical deformations in K2 area were much larger than those in K3. (2) Based on results of magnetotelluric sounding, surface rock survey, and deep drilling lithology verification, columnar granodiorite porphyry veins developed in the lower bottom of strata in K3 area, which has good rock integrity and hard rock quality. The presence of the rock, acting as natural anti-slide piles, ensured, to a certain extent, the stability of the deformation body in the K3 area, and also explained the geological phenomenon that the deformation in K3 was smaller than that in the K2 area. The locking effect of the granodiorite porphyry dike provides a basis for the prediction of the stability of the deformed body.

For further study: https://doi.org/10.1007/s12517-021-08648-1

## OPPOSITE TREE-TREE INTERACTIONS JOINTLY DRIVE THE NATURAL FIR TREELINE POPULATION ON THE SOUTHEASTERN TIBETAN PLATEAU

Yafeng Wang, Qing Mao, Ping Ren, and Shalik Ram Sigdel

The long-term stability of alpine treeline positions and increased stem density are frequently reported by recent studies; however, whether a denser treeline forest is relevant to competitive tree–tree interactions remain unclear. Herein, we mapped and surveyed individual trees in two undisturbed Smith fir (*Abies georgei* var. *smithii*) treeline plots (with a size: 30 m × 200 m; plot NE1: 4477 m, NE2: 4451 m) near Ranwu Lake (RW) on the southeastern Tibetan Plateau. The surface pattern method and spatial point pattern analysis were used to detect the spatial distribution patterns of three size classes (seedlings, juveniles, adults) and spatial associations between the pairwise size classes. We also compared our results to the spatial patterns of the five other treeline forests (Deqin, Linzhi, Changdu, Yushu, Aba) reported from the Tibetan Plateau. Young trees dominated the two fir treeline plots. Both positive and negative spatial autocorrelations for all of the trees were detected in two study plots. Intraspecific facilitation and competition coexisted at the fir treelines in three forest regions (RW, Linzhi, Aba) characterized by a mild moist climate, whereas intraspecific facilitation dominated the other three forest regions (Changdu, Deqin, Yushu), which featured seasonal climatic stress or high disturbance pressure. Thus, increased stem density at alpine treeline can be linked to competitive interactions in relatively favorable environmental conditions. Overall, the spatial patterns of the treeline population are mainly shaped by the combination of thermal and moisture conditions and are also modulated by non-climatic variables (e.g., disturbance history and microtopography).

For further reading: https://doi.org/10.3390/f12101417

# EFFECTS OF ARCTIC SEA ICE IN AUTUMN ON EXTREME COLD EVENTS OVER THE TIBETAN PLATEAU IN THE FOLLOWING WINTER: POSSIBLE MECHANISMS

Miao Bi, Qingquan Li, Song Yang, Dong Guo, Xinyong Shen, and Xiaoting Sun

Extreme cold events (ECEs) on the Tibetan Plateau (TP) exert serious impacts on agriculture and animal husbandry and are important drivers of ecological and environmental changes. We investigate the temporal and spatial characteristics of the ECEs on the TP and the possible effects of Arctic sea ice. The daily observed minimum air temperature at 73 meteorological stations on the TP during 1980–2018 and the BCC_AGCM3_MR model are used. Our results show that the main mode of winter ECEs over the TP exhibits the same spatial variation and interannual variability across the whole region and is affected by two wave trains originating from the Arctic. The southern wave train is controlled by the sea ice in the Beaufort Sea. It initiates in the Norwegian Sea, and then passes through the North Atlantic Ocean, the Arabian Sea, and the Bay of Bengal along the subtropical westerly jet stream. It enters the TP from the south and brings warm, humid air from the oceans. By contrast, the northern wave train is controlled by the sea ice in the Laptev Sea. It originates from the Barents and Kara seas, passes through Lake Baikal, and enters the TP from the north, bringing dry and cold air. A decrease in the sea ice in the Beaufort Sea causes positive potential height anomalies in the Arctic. This change enhances the pressure gradient between the Artic and the mid-latitudes, leading to westerly winds in the northern TP, which block the intrusion of cold air into the south. By contrast, a decrease in the sea ice in the Laptev Sea causes negative potential height anomalies in the Artic. This change reduces the pressure gradient between the Artic and the mid-latitudes, leading to easterly winds to the north of the TP, which favors the southward intrusion of cold polar air. A continuous decrease in the amount of sea ice in the Beaufort Sea would reduce the frequency of ECEs over the TP and further aggravate TP warming in winter.

For further study: https://doi.org/10.1007/s00382-021-06007-0

# FOOD AND GRAIN CONSUMPTION PER CAPITA IN THE QINGHAI–TIBET PLATEAU AND IMPLICATIONS FOR CONSERVATION

Lijing Wang, Yi Xiao, and Zhiyun Ouyang

Grain security is crucial for social stability and ecosystem conservation regionally and globally, and it is particularly concerned widely in the Qinghai-Tibet Plateau (QTP) due to its high altitude and harsh climate for agriculture. In this paper, we calculated and analyzed per capita food and grain consumption, including direct grain consumption, grain for fodder, industry consumption, seeds consumption, and wastage consumption and its changes in the QTP during 1995–2019. The results showed that (1) in 2019, the average food consumption per capita was 333.35 kg, was stable since 1995. The dietary structure of residents was composed of direct grain consumption (44.15%), meat (10.72%), and milk (6.94%). The consumption of meat and milk was higher than the national average. (2) The average daily intake of energy and protein, animal protein, and the ratio of high-quality protein and fat energy were 2156.21 kcal·d$^{-1}$, 73.53 g·d$^{-1}$, 23.06 g·d$^{-1}$, 38.32%, and 27.77% in 2019. Their changes were −342.98 kcal·d$^{-1}$, −8.91 g·d$^{-1}$, 11.16 g·d$^{-1}$, 18.37%, and 11.08%, respectively. (3) The corresponding grain consumption per capita was 284.90 kg·a$^{-1}$ in 1995, 262.19 kg·a$^{-1}$ in 2010, and then remained stable until 2019. The study suggested that food consumption per capital was guaranteed at the well-off level since 2010, and food and dietary structure of residents were corresponding to physical geographic and climatic environment in the QTP. The conflict between food security and the ecosystem conservation can be managed without scarifying nature as the total grain

consumption was stable since 2010, and the yield per unit area and total grain yield were both increasing since 2003 for agricultural condition improved in the QTP.

For further readings:

## DIGITAL FINANCE, GREEN TECHNOLOGICAL INNOVATION AND ENERGY-ENVIRONMENTAL PERFORMANCE: EVIDENCE FROM CHINA'S REGIONAL ECONOMIES

Shaopeng Cao, Liang Nie, Huaping Sun, Weifeng Sun, and Farhad Taghizadeh-Hesary

Conventional finance has many deficiencies in promoting green technology innovation (GTI) and energy-environmental performance (EEP). The emerging digital finance is filling the gaps left by conventional finance with the support of information technology. Using panel data from 2011 to 2017, the paper explores the impact of digital finance on energy-environmental performance in China. The results show that digital finance significantly improves China's energy-environmental performance, which remains robust after a series of tests. Green technology innovation is the transmission path through which digital finance affects energy-environmental performance. The impact mechanism test proves that digital finance affects pure technical efficiency rather than scale efficiency. Furthermore, we also find that digital finance has a greater stimulus effect on energy-environmental performance where credit and capital markets are more immature. Financial supervision and environmental regulation from the Chinese government can reinforce the role of digital finance in promoting energy-environmental performance. Our study suggests that China should accelerate digitization in the financial markets, particularly in pursuit of its energy-saving and emission-reduction effects.

For further readings:

## ECOGEOGRAPHICAL ADAPTATION REVISITED: MORPHOLOGICAL VARIATIONS IN THE PLATEAU BROWN FROG ALONG AN ELEVATION GRADIENT ON THE QINGHAI–TIBETAN PLATEAU

Ka Wah Leung, Shengnan Yang, Xiaoyi Wang, Ke Tang and Junhua Hu

Several anurans have broad elevational and latitudinal distribution ranges; distinct species and populations may face various environmental and selection stresses. Due to their environmental sensitivity, adaptation is critical for the long-term persistence of anurans. Previous studies have tried to identify the ecogeographical pattern and its mechanism in anurans, suggesting different patterns, but the related explanatory mechanisms are yet to be generally supported and are suggested to be complicated. To explore the elusive mechanisms, we studied the morphological variation of the plateau brown frog (*Rana kukunoris*) along an elevational gradient on the eastern margin of the Qinghai–Tibetan Plateau. Using body size, extremity length, and the ratio between them (extremities/body size) as testing indicators, we examined potential ecogeographical adaptations and investigated how environmental and biological factors could shape the morphological development in *R. kukunoris*. We found that males and females showed different variations in body size and extremities along the elevational gradient, whereas both of them showed a decreasing extremities/body size ratio along elevation. Together with the strong correlations between environmental and biological factors and the morphometrics, we identified ecogeographical adaptation and a sexual difference in the selective pressures on the extremities and body size of the plateau brown

frog. Our results imply that geographic variations in anuran morphological traits should be understood as an outcome of environmental and biological factors. Furthermore, ecogeographical adaptation in anurans can manifest as an interactive change between body size and extremities.

For further readings: https://doi.org/10.3390/biology10111081

## SINGLE-SPECIES ARTIFICIAL GRASSLANDS DECREASE SOIL MULTIFUNCTIONALITY IN A TEMPERATE STEPPE ON THE QINGHAI–TIBET PLATEAU

Kelu Chen, Huakun Zhou, Bingbing Lu, Yang Wu, Jie Wang, Ziwen Zhao, Yuanze Li, Mei Wang, Yue Zhang , Wenjing Chen,  Guobin Liu, and Sha Xue

Artificial grasslands have been regarded as an effective method to improve grass production and quality, especially on the Qinghai–Tibet Plateau. Soil ecosystem multifunctionality (EMF) plays an important role in sustainable regional development. However, few studies have investigated the impacts of artificial grasslands on soil EMF. Here, we constructed single-species artificial grasslands in a natural temperate steppe and investigated soil microbial communities, abiotic factors (soil moisture and pH), and functions related to biogeochemical cycles to explore (1) how the transformation from temperate steppe to artificial grasslands affected soil EMF and (2) the roles of species and phylogenetic microbial diversities, microbial community composition, and abiotic factors in driving differences in soil EMF. Our results showed that artificial grasslands decreased soil EMF regardless of planting species; that the bacterial and fungal community composition contributed more to soil EMF prediction than species and phylogenetic diversities; and that microbial phylogenetic diversities were negatively associated with soil EMF. Soil pH played an important role in the effects of artificial grasslands on soil EMF—artificial grasslands increased soil pH, which was negatively associated with soil EMF. Overall, the benefits of establishing artificial grasslands, for example, higher grass production and quality, might be at the expense of soil EMF. Further studies should explore mixed-species artificial grasslands.

For further study: https://doi.org/10.3390/agronomy11112092

## PRIORITIZING CONSERVATION OF BIODIVERSITY IN AN ALPINE REGION: DISTRIBUTION PATTERN AND CONSERVATION STATUS OF SEED PLANTS IN THE QINGHAI-TIBETAN PLATEAU

Tiantian Xue, Sudhindra R. Gadagkar, Thomas P. Albright, Xudong Yang, Jin Li, Changying Xia, Jianyong Wu, and Shengxiang Yu

The Qinghai-Tibetan Plateau (QTP) harbors abundant and diverse plant life owing to its high habitat heterogeneity. However, the distribution pattern of biodiversity hotspots and their conservation status remain unclear. Based on 148,283 high-resolution occurrence coordinates of 13,450 seed plants, we identified hotspots by integrating data from species richness, species complementarity and spatial phylogenetics. Nine hotspot areas were identified that contained 89% of species but covered only 7% of the total land area of the QTP. Four of nine hotspots were identified firstly, including west Nyainqentanglha Mountains, the middle reaches of Lancang and Jinsha Rivers, the upper reaches of Yellow River and Qilian Mountains. Analysis of conservation efficiency indicated national nature reserves (NNRs) covered 55% of the hotspots, whereas NNRs and provincial nature reserves (PNRs) together protected 73% of the hotspots. Conservation efforts, such as establishing new protected areas and upgrading the

level of existing nature reserves, should be strengthened in the conservation gaps. Targeted conservation should be carried out for species endemic to QTP due to their narrow distribution range and low conservation effectiveness. Niche modeling for 336 threatened plants indicated there were apparent range shifts of suitable habitat areas from the eastern edge to the center of the plateau under future climate scenarios, and conservation priority should be focused on the southern QTP for where have stable habitats.

For further reading: https://doi.org/10.1016/j.gecco.2021.e01885

## Bhutan-Himalaya

### PRODUCTIVITY IMPROVEMENT TO SUSTAIN SMALL-SCALE FISH PRODUCTION IN DEVELOPING COUNTRIES: THE CASE OF BHUTAN

Namgay Dorji, Satoshi Yamazaki, and Pema Thinley

Would productivity improvement in small-scale aquaculture "kill two birds with one stone" by simultaneously reducing the tendency to exit production and increasing output? While resource limitations restrict smallholders' involvement in aquaculture, their exit from production is among the factors threatening the sustainability of the aquaculture industry in developing countries. Against this backdrop, the productivity of small-scale aquaculture producers and the ways in which productivity improvement influences their behavior remains insufficiently understood. Based on survey data of 202 fish farmers in Bhutan, this study examined how productivity improvement impacts likelihood of exiting small-scale fish production. Data envelopment analysis was used to compute a slacks-based measure of efficiency as an estimate of productivity. The effect of the resultant estimate of productivity on likelihood of exiting fish production was examined using regression analysis. Results showed that a 10-percentage point increase in productivity among small-scale fish farmers in Bhutan reduced the likelihood of them exiting fish production by 2 percentage points. It is likely that surplus output from productivity improvement and the resultant revenue in the lucrative domestic market motivate Bhutanese farmers to continue fish production. We also found that Bhutan's current aggregate output of farmed fish could be increased by 63% by enabling farmers to produce more efficiently using existing pond sizes and production technologies. Further, it became clear that while subsistence-oriented fish farmers in Bhutan are likely to transition to commercial production, the use of non-cash inputs may be a deterrent. Our findings suggest that productivity improvement has substantial potential to be employed as a policy instrument to reduce the likelihood of farmers exiting small-scale aquaculture and simultaneously increase the aggregate output of farmed fish.

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## Pakistan- Himalaya

### MOUNTAIN PASTORALISM IN THE EASTERN HINDU KUSH: THE CASE OF LOTKUH VALLEY, PAKISTAN

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Pastoral social-ecological systems worldwide are threatened by environmental, climatic, and socioeconomic changes. The magnitude of these threats and their impacts is higher in mountain social-ecological systems. This study analyzes how mountain pastoralists in Lotkuh Valley (Chitral, Pakistan) use their rangelands in changing social, environmental, and climatic contexts. Data were collected from a survey, focus groups, and observations through multistage stratified sampling and extensive fieldwork (2016–2019). The findings reveal that the strategy adopted by mountain pastoralists combines 7 different grazing mechanisms and stall feeding to use spatially segregated and seasonally productive rangeland resources in a sustainable manner. These seasonal mechanisms involve different types of livestock mobility, diverse fodder consumption, and grazing patterns. In winter, livestock are kept in stalls near the village. During spring, sheep and goats are taken to nearby low-lying pastures and meadows on a rotation basis. In summer, livestock and people move away from the village to settlements along a 3000 m elevational range to graze on the available pastures. Finally, in autumn, as the livestock descend, they browse intensively on stubble fields before the winter crops are planted. Furthermore, this strategy is based on the coordination of households' available labor force and pasture readiness. This study provides nuanced information on mountain pastoralists and rangeland management systems. The findings are useful for policymakers and practitioners in designing effective programs and policies to decrease the vulnerability and enhance the resilience of mountain social-ecological systems.