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Editorial Team: Prabhat Adhikari and Rejina Khanal

For the 577-578th issues of Headlines Himalaya, we reviewed journal articles from three sources and selected nine happenings from four countries. We selected six happenings from Nepal and three happenings from other Himalayan countries (India, Bhutan and Pakistan). The overall coverage of this issue is biodiversity, agriculture, wildlife, climate change and environment.

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WATER DIVERSION INDUCED CHANGES IN AQUATIC BIODIVERSITY IN MONSOON-DOMINATED RIVERS OF WESTERN HIMALAYAS IN NEPAL: IMPLICATIONS FOR ENVIRONMENTAL FLOWS

Ram Devi Tachamo Shah, Subodh Sharma, Luna Bharati

Ecological Indicators 108 (2020): 105735

Water diversion projects across the world, for drinking water, energy production and irrigation, have threatened riverine ecosystems and organisms inhabiting those systems. However, the impacts of such projects on aquatic biodiversity in monsoon-dominated river ecosystems are little known, particularly in Nepal. This study examines the effects of flow reduction due to water diversion projects on the macroinvertebrate communities in the rivers of the Karnali and Mahakali basins in the Western Himalayas in Nepal. Macroinvertebrates were sampled during post-monsoon (November), baseflow (February) and pre-monsoon (May) seasons during 2016 and 2017. Non-metric Multidimensional Scaling (NMDS) was performed to visualize clustering of sites according to percentage of water abstractions (extraction of water for various uses) and Redundancy Analysis (RDA) was used to explore environmental variables that explained variation in macroinvertebrate community composition. A significant pattern of macroinvertebrates across the water abstraction categories was only revealed for the baseflow season. NMDS clustered sites into three clumps: “none to slight water abstraction (<30% – Class 1)”, “moderate water abstraction (>30% to <80% – Class 2)” and “heavy water abstraction (>80% – Class 3)”. The study also showed that water abstraction varied seasonally in the region (Wilk’s Lambda = 0.697, F(2, 28) = 4.215, P = 0.025, $\eta^2 = 0.23$). The RDA plot indicated that taxa such as *Acentrella* sp., *Paragenetina* sp., *Hydropsyche* sp., *Glossosomatinae*, Elmidae, Orthoclaadiinae and Dimesiinae were rheophilic i.e. positively correlated with water velocity. Taxa like *Torleya* sp., *Caenis* sp., *Cinygmmina* sp., *Choroterpes* sp., Limoniidae and Ceratopogoniidae were found in sites with high proportion of pool sections and relative high temperature induced by flow reduction among the sites. Indicator taxonomic groups for Class 1, 2 and 3 water abstraction levels, measured through high relative abundance values, were Trichoptera, Coleoptera, Odonata and Lepidoptera, respectively. Macroinvertebrate abundance was found to be the more sensitive metric than taxonomic richness in the abstracted sites. It is important to understand the relationship between flow alterations induced by water abstractions and changes in macroinvertebrates composition in order to determine sustainable and sound management strategies for river ecosystems.

For further details: <https://doi.org/10.1016/j.ecolind.2019.105735>

PLANT USE VALUES AND PHYTOSOCIOLOGICAL INDICATORS: IMPLICATIONS FOR CONSERVATION IN THE KAILASH SACRED LANDSCAPE, NEPAL

Ripu M. Kunwar, Maria Fadiman, Santosh Thapa, Ram P. Acharya, Mary Cameron, Rainer W. Bussmann

Ecological Indicators 108 (2020): 105679

Human communities that inhabit rural, remote, rugged and biodiverse environments adopt diverse livelihood strategies such as utilizing different ethno-ecological environments. The present study explores how people use plant resources in the context of availability and accessibility of plants and habitats, and diversity of culture. We hypothesize that people are most likely to forage the most visible and accessible plants and habitats frequently. This relationship was tested in the Darchula and Baitadi districts of the Kailash Sacred Landscape Nepal, using data from phytosociological studies and community interviews. Total use values, medicinal use values and other use values of plants were used for analyses. Plant availability was assessed by using phytosociological indicators. The accessibility was tested by using the use values of plants with reference to the site-specific explanatory variables:

forest/non-forest habitat, nearby/transition/distant area, hill/mountainous district, and Himalayan endemic/Pan-Himalayan/cosmopolitan distribution. A weak association between plant use values and plant availability and site accessibility was recorded. However, the plant use value was influenced by ecological (Shannon diversity, species richness) and cultural indicators (preference for specific products and recognition) and varied at the level of use category (medicinal and non-medicinal). Higher medicinal use values at Darchula district indicate that the knowledge of plant collection and use was more dependent on quality of products and directed harvesting and less influenced by availability of resources and accessibility of sites. Since plant apparency was not found to always be the most important indicator, social and cultural factors appear to be as the most influential indicators.

For further details: <https://doi.org/10.1016/j.ecolind.2019.105679>

SUSTAINABILITY ASSESSMENT OF CROP PRODUCTION IN ACCORD WITH ENERGY, ENVIRONMENT AND ECONOMIC PERFORMANCES IN NEPAL

Anil Pokhrel and Peeyush Soni

Environmental Sustainability 2 (2019): 343-353

Increasing crop production usually warrants increased use of energy in the system that triggers the question of locating an 'appropriate' operating point by weighing the economics of output and its environmental impacts. Sustainability of diverse cereals, legumes and vegetable production systems were assessed in lowlands of Nepal in light of the efficiency of energy use, CO₂e (carbon dioxide equivalent) emissions and financial return–cost ratios. The energy saving potential of 238 farms selected in the study area is calculated adopting Data Envelopment Analysis (DEA). Based on the per-hectare energy consumption, vegetables (12.37 GJ), cereals (10.60 GJ) and legumes (3.80 GJ) crop production systems are ranked in descending order. Rice offered the highest per-hectare energy output (68.99 GJ) among the selected crops. Potential saving of energy inputs in the study area is shown to be between 18 and 35% without conceding yield of the particular crop production system. The highest environmental impact is due to garlic production (2997.13 kg CO₂e ha⁻¹); while rice, maize, wheat, lentil, mungbean and onion crops emit 60, 63, 28, 5, 3 and 86% CO₂e emissions (of that of garlic crop), respectively. As expected, the vegetable production remains the most profitable system with the return–cost ratio of 2.96–3.52, followed by legume (1.83–2.16) and cereal (1.21–1.96) production systems.

For further details: <https://doi.org/10.1007/s42398-019-00076-y>

CONTRIBUTION OF BUFFER ZONE PROGRAMS TO REDUCE HUMAN-WILDLIFE IMPACTS: THE CASE OF THE CHITWAN NATIONAL PARK, NEPAL

Babu Ram Lamichhane, Gerard A. Persoon, Herwig Leirs, Shashank Poudel, Naresh Subedi, Chiranjibi Prasad Pokheral, Santosh Bhattarai, Pabitra Gotame, Rama Mishra, and Hans H. de longh

Human Ecology 47 (2019): 95-110

Buffer zones around parks/reserves are designed to maintain ecological integrity and to ensure community participation in biodiversity conservation. We studied the fund utilization pattern of buffer zone programs, mitigation measures practiced, and attitudes of residents in buffer zone programs of Chitwan National Park, Nepal. The buffer zone committees spent only a small portion (13.7%) of their budget in direct interventions to reduce wildlife impacts. Human-wildlife conflicts were inversely related to investment in direct interventions for conflict prevention and mitigation. Peoples' attitudes towards wildlife conservation were largely positive. Most of the people were aware of buffer zone programs but were not satisfied with current practices. We recommend that buffer zone funds be concentrated into direct interventions (prevention and mitigation) to reduce wildlife conflicts. Our findings will be helpful in prioritizing distribution of funds in buffer zones of parks and reserves.

For further details: <https://doi.org/10.1007/s10745-019-0054-y>

IMPACT OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTIVITY AND FOOD SECURITY IN THE HIMALAYAS: A CASE STUDY IN NEPAL

D. Bocchiola, L. Brunetti, A. Soncini, F. Polinelli, and M. Gianinetto

Agriculture Systems 171 (2019): 113-125

The paradigmatic Dudh Koshi basin laid at the toe of Mt. Everest is largely visited by tourists every year, and yet agricultural productivity and food security therein are at stake under climate change. Agricultural yield in the area recently decreased, and the question arose whether cropping at higher altitudes may help adaptation. We investigated here the present, and future (until 2100) patterns of productivity of three main rain-fed crops in the catchment (wheat *Triticum* L., rice *Oryza* L., and maize *Zea Mais* L.). We explored food security using a nutritional index, given by the ratio of the caloric content from our target cereals, to daily caloric demand. We preliminarily investigated whether vertical extension of the cropped area may increase food security. We did so by (i) mapping crops area using remote sensing, (ii) setting up the agronomic model *Poly-Crop*, (iii) feeding *Poly-Crop* with downscaled outputs from global climate models, and (iv) projecting vertical land occupation for cropping, population projections, and nutritional requirements. We estimated crop yield and food security at half century (2040–2050), and end of century (2090–2100), against a control run decade CR (2003–2013), under constant land use, and projected land occupation. On average, specific wheat yield would decrease against CR by –25% (rice –42%, maize –46%) at 2100, with largely yearly variability for unchanged land use scenario. Under modified land use scenario, wheat yield would decrease by –38%, while rice and maize yield would improve, maize very slightly (–22%, and –45%, against CR) in response to occupation of higher altitudes than now. Our food security index would decrease under all scenarios (111% in 2010, 49% on average at 2050, under a population peak, and 51% at 2100), and become more variable, however with potential for adaptation by colonization of higher lands (75%, 62%, at 2050, 2100). Very large expansion of one cereal (i.e. maize), may make food security more unstable, as mostly depending on erratic yield of that cereal only.

For further details: <https://doi.org/10.1016/j.agsy.2019.01.008>

IMPACTS OF FOREST MANAGEMENT ON TREE SPECIES RICHNESS AND COMPOSITION: ASSESSMENT OF FOREST MANAGEMENT REGIMES IN TARAI LANDSCAPE NEPAL

Bishnu Hari Poudyal, Tek Maraseni, Geoff Cockfield

Applied Geography 111 (2019): 102078

The role of natural (non-plantation) production forests is increasingly recognized in conservation of forest biodiversity globally. Government and other forest stakeholders in Nepal are, however, still reluctant to promote active management of production forests for fear of negative impacts on forest biodiversity. Moreover, Nepal's government is converting production forests into protected areas thus restricting the area available for multiple uses. To assess the implications of forest management practices on forest biodiversity at landscape level, we compared the richness and composition of tree species among regularly harvested community forests, irregularly harvested community forests, protected area and national forests in sub-tropical forested landscape of Nepal using tree species inventory and assessment of key environmental variables. Results showed that regularly harvested community forests could be effective in supporting tree species richness and composition compared to other management regimes. Results supported the hypothesis that high forest disturbance and no disturbance do not support tree species diversity and composition. In addition, this study found that regularly managed community forests also protect ecologically important and vulnerable tree species. Some possible explanations for

the better performance of these community forests could be tenure security, frequency and regularity of silvicultural operations and sensitivity of forest users to the ecological aspects of forest management. Our study reaffirmed the need for active forest management at the local level to contribute to global conservation initiatives such as sustainable forest management, reducing emissions from deforestation and forest degradation in developing countries (REDD+) and biodiversity conservation. Better compliance with forest management plans and capacity development of local forestry stakeholders in forest management operations are suggested for managing forests outside protected areas that is, in national and community forests.

For further details: <https://doi.org/10.1016/j.apgeog.2019.102078>

India-Himalaya

DIVERSITY AND DISTRIBUTION OF ARBUSCULAR MYCORRHIZAL FUNGI IN POME AND STONE FRUIT ORCHARDS OF NORTH WESTERN HIMALAYAN STATE OF JAMMU & KASHMIR

Baby Summuna, Parveez A. Sheikh, Sachin Gupta, Waseem Ali Dar, and G. H. Dar

Indian Phytopathology 72 (2019): 343-350

A study was conducted to assess the diversity and distribution of arbuscular mycorrhizal fungi (AMF) in pome (apple and pear) and stone (cherry) fruit orchards in North Western Himalayan Kashmir. A total of 222 AMF isolates were isolated from the rhizosphere of apple, pear and cherry plants from the four districts of Kashmir valley viz., Srinagar, Ganderbal, Baramulla and Shopian. The maximum number of AMF isolates were found in district Baramulla (60) followed by Ganderbal (57), Srinagar (53) and Shopian (52) with Simpson's species diversity index of 0.58. Twenty-nine AMF species, belonging to 7 genera were identified, besides 16 species belonging to three genera were identified up to genus level. Out of these, six species viz., *Glomus xanthium*, *Scutellospora tricalypta*, *S. armeniaca*, *Dentiscutata erythropha*, *Septoglomus deserticola* and *S. constrictum* have not been reported from India so far so these are the first records from India. *Glomus* species was the most common and predominant AM fungus with frequency occurrence of 60.75%, followed by *Acaulospora* spp. (22.82%), *Scutellospora* spp. (8.05%) and *Septoglomus* spp. (4.69%). However, *Dentiscutata* spp., *Fumneliformis* spp. and *Gigaspora* spp. were rarely encountered.

For further details: <https://link.springer.com/article/10.1007/s42360-019-00120-1>

Bhutan-Himalaya

THE SPATIAL DISTRIBUTION AND POPULATION DENSITY OF TIGERS IN MOUNTAINOUS TERRAIN OF BHUTAN

Tshering Tempa, Mark Hebblewhite, Jousha F. Goldberg, Nawang Norbu, Tshewang R. Wangchuk, Wenhong Xiao, and L. Scott Mills

Biological Conservation 238 (2019): 108192

Habitat loss, prey depletion, and direct poaching for the illegal wildlife trade are endangering large carnivores across the globe. Tigers (*Panthera tigris*) have lost 93% of their historical range and are experiencing rapid population declines. A dominant paradigm of current tiger conservation focuses on conservation of 6% of the presently occupied tiger habitat deemed to be tiger source sites. In Bhutan, little was known about tiger distribution or abundance during the time of such classification, and no part of the country was included in the so-called 6% solution. Here we evaluate whether Bhutan is a potential tiger source site by rigorously estimating tiger density and spatial distribution across the country. We used large scale remote-camera trapping across $n = 1129$ sites in 2014–2015 to survey all potential tiger range in Bhutan. We estimated 90 individual tigers (60 females) and

a mean density of 0.23 adult tigers per 100 km². Bhutan has significantly higher numbers of tigers than almost all identified source sites in the 6% solution. With low human density and large swaths of forest cover, the landscape of Bhutan and adjacent northeast India is a promising stronghold for tigers and should be prioritized in large-scale conservation efforts.

For further details: <https://doi.org/10.1016/j.biocon.2019.07.037>

Pakistan- Himalaya

IMPACT ASSESSMENT OF LAND USE CHANGE ON SURFACE TEMPERATURE AND AGRICULTURAL PRODUCTIVITY IN PESHAWAR-PAKISTAN

Imran Khan, Tehseen Javed, Ahmad Khan, Hongdou Lei, Ihsan Muhammad, Imad Ali, and Xuexi Huo

Environmental Science and Pollution Research 26 (2019): 33076-33085

The profound appreciation of urban expansion and land use change (LUC) considerably influences the ecosystem functions, services, and biodiversity along with the local and regional climate. Land use has undergone an awful transformation due to rapid urbanization and population growth, which in turn increased land surface temperature (LST) in district Peshawar, Pakistan. The current study tends to capture the influence of land use on LST and agricultural productivity by employing multi-temporal, multispectral satellite data and agricultural production data during the selected years, i.e., 1996, 2003, and 2016. The results demonstrated that barren land considerably decreased while the urban area increased over time in all three phases. Furthermore, significant LST difference was found in different land cover units; e.g., barren land and urban area have the maximum, while water bodies followed by vegetation retain minimum LST in all three phases, i.e., 1996, 2003, and 2016. Similarly, the results from agricultural production revealed that except for wheat crops, which decreased by 7.54% during 1999–2003, the production of all major food crops increased during the selected years. However, the production of sugar cane and barley experienced considerable reduction during the selected years, except for barley, which increased by 22.86% during 2003–2016. The finding of this study provides guidance, policy recommendations, and reference for future researchers.

For further details: <https://link.springer.com/article/10.1007/s11356-019-06448-5>