

# Headlines Himalaya

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Editorial Team: Abish Man Shakya and Sadikshya Wosti

For the 597- 598<sup>th</sup> issues of Headlines Himalaya, we reviewed journal articles from five sources and selected eighteen researches from five countries. We selected four researches from Nepal and fourteen researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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## **Nepal-Himalaya**

### **MAJOR IONS AND IRRIGATION WATER QUALITY ASSESSMENT OF THE NEPALESE HIMALAYAN RIVERS**

Chhatra Mani Sharma, Shichang Kang, Lekhendra Tripathy, Rukumesh Paudyal, and Mika Sillanpää  
*Environment, Development and Sustainability* 2020: 1-13

Water quality analysis of the Himalayan rivers for irrigation was carried out in 2013 that include the Dudh Koshi, Indrawati, Gandaki and Bagmati rivers from Nepal. Former three rivers originate at high altitudes and are glacier-fed rivers, whereas the Bagmati River originates at the high hill and flows through the capital city of Nepal. The river water samples were collected at 93 sites representing river from lowlands, mid-hills and high mountains of the Himalayas. Nine major ions ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{HCO}_3^-$  and  $\text{NO}_3^-$ ), pH, EC and TDS were analyzed so as to assess the water quality for irrigation. Irrigation water quality was assessed by calculating sodium adsorption ration (SAR), soluble sodium percentage (SSP or %Na) and water quality index (WQI). Although SAR indicated that all the water samples were having low values and could be suitable for the irrigation purpose, some sites from the Bagmati River were having high class of EC, rendering it not good for irrigation. Similar results were indicated by %Na as well as WQI results where low water qualities were observed from some highly contaminated sites in the city area. This clearly indicates the impacts of urbanization (anthropogenic) in river water quality for the irrigation in the Himalayan rivers of Nepal.

For further reading: <https://doi.org/10.1007/s10668-020-00694-1>

## **India-Himalaya**

### **EXPLORING LIVELIHOOD STRATEGIES OF SHIFTING CULTIVATION FARMERS IN ASSAM THROUGH GAMES**

Swen P. M. Bos, Tina Cornioley, Anne Dray, Patrick O. Waeber, and Claude A. Garcia  
*Sustainability* 12: 2438

Understanding landscape change starts with understanding what motivates farmers to transition away from one system, shifting cultivation, into another, like plantation crops. Here we explored the resource allocation strategies of the farmers of the Karbi tribe in Northeast India, who practice a traditional shifting cultivation system called jhum. Through a participatory modelling framework, we co-developed a role-playing game of the local farming system. In the game, farmers allocated labour and cash to meet household needs, while also investing in new opportunities like bamboo, rubber and tea, or the chance to improve their living standards. Farmers did embrace

new options where investment costs, especially monetary investments, are low. Returns on these investments were not automatically re-invested in further long-term, more expensive and promising opportunities. Instead, most of the money is spent on improving household living standards, particularly the next generation's education. The landscape changed profoundly based on the farmers' strategies. Natural ecological succession was replaced by an improved fallow of marketable bamboo species. Plantations of tea and rubber became more prevalent as time progressed while old practices ensuring food security were not yet given up.

For further reading: <https://doi.org/10.3390/su12062438>

#### **PETROGRAPHY AND CLAY MINERALOGICAL STUDY OF THE SIWALIK GROUP OF ROCKS EXPOSED ALONG PASIGHAT-MARIYANG ROAD SECTION, EAST SIANG DISTRICT, ARUNACHAL PRADESH, NORTHEAST INDIA**

Ananya Chutia, Chaitra Dhar Taye, Jagriti Daimari, and Debasish Chutia

*Journal of the Geological Society of India* 95: 263–272

The Neogene (Mio-Pliocene) molassic sediments occur as a linear belt along the foot hills of Arunachal Pradesh, are designated as the Siwalik Group. Petrography, heavy mineral and clay mineralogical characteristics of these rocks exposed along Pasighat-Mariyang road section, East Siang district, Arunachal Pradesh, India is presented here. These massive and well bedded rocks are detached from alluvium by HFT and remarkably from Yinkiong Group of rocks by MBT. The present study reveals the presence of lower as well as middle-upper Siwalik in the study area. Petrographic study of the sandstones has shown that these rocks are mainly sub-arkose and sub-litharenite with lithic and feldspathic greywacke in subordinate amount, which are medium to coarse grained and composed mainly of quartz, feldspar, mica and rock fragments as their detrital constituents. Argillaceous and siliceous matrix as well as argillaceous, carbonate and siliceous cement are binding the framework grains. These sediments were derived mainly from middle to upper grade metamorphic rocks. During deposition these rocks have undergone shallow depth as well as deeper level diagenesis and the climate prevailed was humid and tropical.

For further reading: <https://doi.org/10.1007/s12594-020-1424-1>

#### **THE ROLE OF SOCIAL INFLUENCE IN CROP RESIDUE MANAGEMENT: EVIDENCE FROM NORTHERN INDIA**

Adrian A. Lopes, Ajalavat Viriyavipart, and Dina Tasneem

*Ecological Economics* 169: 106563

Postharvest crop residue burning, which is associated with negative environmental and health outcomes, has become a major public policy concern in developing countries. We use original survey data from 1230 rice farmers in Northern India to analyze the factors influencing crop residue management practices. Results indicate that herd behavior is a significant determinant of residue burning, wherein a farmer is socially influenced to choose burning as the residue management technique because he believes all other farmers commonly practice it. We find that farmers who perceive residue burning as diminishing soil quality are far less likely to do so; however, their awareness of its adverse environmental effects does not lower the choice to burn. We infer that farmers account for private costs and benefits of burning but ignore its external social costs. We also control for socio-economic factors and find that farmer's wealth increases the likelihood of residue burning. Identifying the behavioral factors behind residue burning, which capture underlying aspects of social influence and herd behavior is useful for policy aimed at reducing this public health hazard.

For further reading: <https://doi.org/10.1016/j.ecolecon.2019.106563>

## China Himalaya

### **ACCELERATED CHANGES OF GLACIERS IN THE YULONG SNOW MOUNTAIN, SOUTHEAST QINGHAI-TIBETAN PLATEAU**

Shijin Wang, Yanjun Che, Hongxi Pang, Jiankuo Du, and Zhonglin Zhang

*Regional Environmental Change* 20: 1-13

The Yulong Snow Mountain (YSM) is a region of temperate glaciers in the southeast Qinghai-Tibetan Plateau. The present study systematically assessed the glacier changes during the past several decades using ground-based and remotely sensed observations and referencing topographic maps. The images and maps revealed that the glaciers area in the YSM retreated by 64.02% from 1957 to 2017. The length of Baishui River Glacier No. 1 decreased by 12.5 m/year during this period, whereas the front elevation of this glacier increased by 10.83 m/year. The mean annual mass balance of this glacier was at  $-0.42$  metre water equivalent from 1957 to 2017, and its accumulative mass balance was  $-27.45$  metre water equivalent. The glacier retreats of glacier area, glacier front, and mass balance in the YSM primarily resulted from the increasing air temperature. These glacier retreats not only will have a negative impact on glacier tourism in the future, e.g., the retreat or disappearance of glaciers will reduce the attractiveness of mountainous scenic spots, but also will create new opportunities for the development of local tourism, e.g., “last chance” will simulate tourists’ curiosity. Hence, the findings of our present study help to understand the mechanism between accelerated ablation of temperate glaciers and climate change in southeast regions of Qinghai-Tibetan Plateau and provide references for local tourism administrations.

For further reading: <https://doi.org/10.1007/s10113-020-01624-7>

### **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>

#### **SUSPENDED SEDIMENT TRANSPORT RESPONSES TO INCREASING HUMAN ACTIVITIES IN A HIGH-ALTITUDE RIVER: A CASE STUDY IN A TYPICAL SUB-CATCHMENT OF THE YARLUNG TSANGPO RIVER**

Zhe Huang, Binliang Lin, Jian Sun, Nima Luozhu, Ping Da, and Jinmei Dawa

*Water* 12: 952

The Yarlung Tsangpo River is one of the highest major rivers in the world. The river is known for its pristine landscape. However, in recent years, increasing human activities, such as inhabitation, afforestation, and infrastructure projects, have significantly disturbed this fluvial system, while their impacts are not fully known. In this study, the water and sediment transport processes in the Nugesha–Yangcun (N–Y) reach of the Yarlung Tsangpo River, as well as the impact of human activity, are investigated. The N–Y sub-catchment consists of two parts, i.e., the Lhasa River catchment and the mainstream catchment. Riverine discharge, suspended sediment concentration (SSC), and precipitation data are acquired, and a detailed investigation is conducted. The water yield has not changed considerably in recent years, while the sediment yield has exhibited a sharp decline, from ~5 Mt to ~1 Mt. The sediment decrease is mainly caused by the reduced sediment source, which is considered highly related to afforestation. In addition, the dominant sediment contributor has changed from the mainstream catchment to the tributary catchment (while the sediment yield in the mainstream catchment has decreased to almost zero). An anomalously enhanced SSC occurred in the Lhasa River in two consecutive years from 2015, with the SSC value increasing sharply from 0.2 kg/m<sup>3</sup> to 0.8 kg/m<sup>3</sup>, and maintaining a high level for approximately three months. This phenomenon is considered to be related to infrastructure projects in the same period, with the SSC recovered after road construction ended. The increasing human activities have had significant impacts on the sediment regimes in the Yarlung Tsangpo River; hence, more attention should be paid to river basin management.

For further reading: <https://doi.org/10.3390/w12040952>

#### **EARLY CARBONIFEROUS BLACK MUDSTONES IN THE NUJIANG SUTURE ZONE IN NORTHEAST TIBET: IMPLICATION ON PALEOENVIRONMENT**

Junwei Qiao, Yong Qin, Shuzheng Ning, and Fangpeng Du

*Arabian Journal of Geosciences* 13: 279

Early Carboniferous sedimentary rocks were distributed in various landmasses or microlandmasses and suture zones in the northeastern Tibet. The section of black mudstones of the lower Carboniferous Bangda Formation was found at Kaqiong microlandmasses of Nujiang Suture Zone north of Lhorong County. The section is composed of black silty mudstone and mudstone subjected to slight metamorphism. In order to determine the paleoenvironment, provenance, and tectonic background of black mudstones, geological survey and geochemical data of this section were discussed. The results show that the TOC content of black mudstones ranges from 1.86 to 13.14%, and the organic matter is mainly sapropelic. The black mudstones with lower Sr/Ba and Sr/Cu values indicate a warm and humid climatic environment during the sedimentary period. The higher U (authigenic), U/Th,

and Ni/Co values of mudstones indicate the reduced environment in the sedimentary period, but there is a rapid oxidation environment in the middle of the sedimentary period. This abrupt change results in the “two-stage” distribution of TOC and related geochemical properties. Total REE concentrations of mudstones range from 155.9 to 346.2 µg/g. All samples have chondrite-normalized REE patterns with enrichment of LREE, depletion of HREE, and negative Eu anomaly. The binary diagrams of Ni-TiO<sub>2</sub> and La/Th-Hf and the Al<sub>2</sub>O<sub>3</sub>/TiO<sub>2</sub> ratios indicate that the black mudstone mainly derived from felsic provenance. The discrimination diagrams revealed that the source rocks were mostly deposited in a collision setting.

For further reading: <https://doi.org/10.1007/s12517-020-5252-9>

## Bhutan-Himalaya

### **SPATIO-TEMPORAL LANDSCAPE CHANGES AND THE IMPACTS OF CLIMATE CHANGE IN MOUNTAINOUS BHUTAN: A CASE OF PUNATSANG CHHU BASIN**

Ngawang Chhogyel, Lalit Kumar, and Yadunath Bajgai  
*Remote Sensing Applications: Society and Environment* 18: 100307

Agro-ecological landscape changes along the Punatsang Chhu (River) Basin of Bhutan were assessed using Geographic Information System (GIS) and Remote Sensing techniques. The study used satellite data (Landsat imageries) of three periods (1996, 2010 and 2017). The results showed a 51% reduction in the snow and glacial area over the last 20 years. Further, the area under rock outcrops and bare land almost doubled from 8 % in 1996 to 15 % in 2017 during the same period. These changes could be directly related to the impacts of climate change since the study site showed increases in both maximum and minimum temperatures by about 1 °C and 0.5 °C, respectively based on 1997 to 2017 data. The seasonal average rainfall during the same period also showed a decreasing trend from a high of about 800 mm to 400 mm, which might have affected snow and glacier cover in the higher mountains. Thus, this research further confirms the existing knowledge that climate change impacts are more severely felt in the high altitudes and mountainous locations, such as the Himalayas. The study highlights land cover changes due to climate change and anthropogenic factors which could be used for suitable policy interventions and management of natural resources.

For further reading: <https://doi.org/10.1016/j.rsase.2020.100307>

### **A COMPARISON OF THE QUALITATIVE ANALYTIC HIERARCHY PROCESS AND THE QUANTITATIVE FREQUENCY RATIO TECHNIQUES IN PREDICTING FOREST FIRE-PRONE AREAS IN BHUTAN USING GIS**

Kinley Tshering, Phuntsho Thinley, Mahyat Shafapour Tehrani, Ugyen Thinley, and Farzin Shabani  
*Forecasting* 2: 36-58

Forest fire is an environmental disaster that poses immense threat to public safety, infrastructure, and biodiversity. Therefore, it is essential to have a rapid and robust method to produce reliable forest fire maps, especially in a data-poor country or region. In this study, the knowledge-based qualitative Analytic Hierarchy Process (AHP) and the statistical-based quantitative Frequency Ratio (FR) techniques were utilized to model forest fire-prone areas in the Himalayan Kingdom of Bhutan. Seven forest fire conditioning factors were used: land-use land cover, distance from human settlement, distance from road, distance from international border, aspect, elevation, and slope. The fire-prone maps generated by both models were validated using the Area Under Curve

assessment method. The FR-based model yielded a fire-prone map with higher accuracy (87% success rate; 82% prediction rate) than the AHP-based model (71% success rate; 63% prediction rate). However, both the models showed almost similar extent of 'very high' prone areas in Bhutan, which corresponded to coniferous-dominated areas, lower elevations, steeper slopes, and areas close to human settlements, roads, and the southern international border. Moderate Resolution Imaging Spectro-radiometer (MODIS) fire points were overlaid on the model generated maps to assess their reliability in predicting forest fires. They were found to be not reliable in Bhutan, as most of them overlapped with fire-prone classes, such as 'moderate', 'low', and 'very low'. The fire-prone map derived from the FR model will assist Bhutan's Department of Forests and Park Services to update its current National Forest Fire Management Strategy.

For further reading: <https://doi.org/10.3390/forecast2020003>

#### **ASSESSING THE IMPACTS OF VEHICLE WASH WASTEWATER ON SURFACE WATER QUALITY THROUGH PHYSICO-CHEMICAL AND BENTHIC MACROINVERTEBRATES ANALYSES**

Reeta Raj, Subodh Sharma, D.B. Gurung, Bishal K. Sitaula, and Ram Devi Tachamo Shah  
*Water Science* (2020): 1-11

Vehicle wash wastewater (VWW) contains a wide range of contaminants and discharge of such contaminated wastewater into the surface water bodies degrade water quality and affect aquatic ecosystems. This study, presents an impacts of discharging VWW into the stream Olarong Chhu in Thimphu and river Paa Chhu in Paro using water chemistry and benthic macroinvertebrates data sets obtained over a period of 6 months. Water samples and benthic macroinvertebrates were sampled once in a month from upstream, impact, and downstream sites in premonsoon (March to May) and post-monsoon (September to November) seasons in 2016. Significant levels of contaminants associated with vehicle washing were detected in water samples of impact sites whose cumulative effects on benthic macroinvertebrate assemblages were supported by HKHbios index, biological indices, and statistical analyzes. Canonical correspondence analysis indicated that T, dissolved oxygen, pH, biological oxygen demand, chemical oxygen demand, total suspended solids, turbidity, oil and grease, and sulfate significantly alter water quality and affect benthic macroinvertebrate assemblages. With the increasing number of vehicles, management of VWW is becoming a serious issue in Bhutan. Hence, there should be proper enforcement of water and environmental legislations and effective measures like constructions of wastewater treatment facilities should be considered for protecting Bhutan's surface water resources and aquatic ecosystems.

For further reading: <https://doi.org/10.1080/11104929.2020.1731136>

## **Pakistan- Himalaya**

#### **TRADITIONAL WILD VEGETABLES GATHERED BY FOUR RELIGIOUS GROUPS IN KURRAM DISTRICT, KHYBER PAKHTUNKHWA, NORTH-WEST PAKISTAN**

Wasim Abbas, Wajid Hussain, Wahid Hussain, Lal Badshah, Kamal Hussain, and Andrea Pieroni  
*Genetic Resources and Crop Evolution* 67: 1521-1536

Studying how traditional knowledge regarding wild food plants and particularly wild vegetables changes over time and space is crucial for understanding which socio-ecological variables may have an influence on traditional

foraging behaviors. Recent work has found that religious affiliation may play a central role since, in specific cultural contexts, religion shapes kinship relations and consequently the vertical transmission of traditional knowledge and practices. In order to further test this hypothesis, a field ethnobotanical study specifically focusing on wild vegetables was conducted among four religious communities (Shias, Sunnis, Christians, and Sikhs) in Kurram District, North-West Pakistan. Results show that a remarkable bio-cultural heritage comprising fifty-five folk wild food taxa survives today; most of the wild plants were however quoted by few informants, suggesting that this traditional knowledge system is possibly under threat. More than the half of the quoted wild vegetables were not yet reported so far in the Pakistan wild food ethnobotanical literature. The most commonly gathered wild vegetables were *Amaranthus viridis L.*, *Margarospermum officinale L.*, *Malva neglecta Wallr.*, *Portulaca oleracea L.*, and *Rumex dentatus L.* Most of the recorded wild vegetables were quoted by Shia and, to less extent, by Sunni community members, while Christians and Sikhs showed an extremely restricted wild plant food repertoire. These differences may be related to the different history and socio-economic conditions of the considered religious groups, to geographical/ecological factors and probably to the very specific origin of the Shia groups (Turi tribe) of the region, which moved from Western Asia a few centuries ago. Moreover, a remarkable portion of the quoted wild vegetables are perceived to have specific medicinal properties. A serious reconsideration of the recorded wild food plant resources, especially also within educational platforms, could be crucial for fostering culturally-appropriate food security strategies in marginal areas of Pakistan.

For further reading: <https://doi.org/10.1007/s10722-020-00926-3>

#### **DISASTER MITIGATION IN URBAN PAKISTAN USING AGENT BASED MODELING WITH GIS**

Ayesha Maqbool, Zain ul Abideen Usmani, Farkhanda Afzal and Alia Razia  
*International Journal of Geo-Information* 9: 203

This study aims to propose an application of agent based modeling (ABM) and simulation for disaster mitigation in an urban region of Pakistan. Pakistan has been working over the past few decades to reduce the risk factor of disasters by using different disaster management approaches. However, these efforts are in an early stage. Although lack of planning and unchecked urbanization are the main hurdles, insufficient resources in terms of technology is also a major contributing factor that impedes achieving desired results. In this paper, we are proposing ABM and simulation of approaches using geographical information system (GIS) maps for disaster management in the urban locality of Pakistan. The conceptual model was implemented for analysis of resource allocation (RA) of first response units (ambulances, fire brigade, etc.). In the proposed model, we used two allocation algorithms; high severity level (HSL) and first come first serve (FCFS). These algorithms were simulated in NetLogo by creating a hypothetical disaster scenario in Rawalpindi city. In our experiments, the design was based on demand, resource agents, and their allocation behavior for disaster management. We analyzed the resource allocation mechanism using average wait time, overall number of demands, execution time, and unallocated demands as performance measures.

For further reading: <https://doi.org/10.3390/ijgi9040203>