

Headlines Himalaya

January 15 – 31 (2023)

No. 731–732

Editorial Team: Adesh Atreya and Madan Oli

For the 731st-732nd issues of Headlines Himalaya, we reviewed research papers from five sources and selected 13 research papers from five countries. We selected four research papers from Nepal and nine from other Himalayan Countries (India, China, Bhutan and Pakistan).

Headlines Himalaya, a weekly research-based fact file is an attempt to keep our global readers abreast with the happenings in the Himalaya. Please share it with your colleagues and friends. Also, subscription is free. Enjoy!

NEPAL *UNDERSTANDING LOCAL ECOSYSTEM DYNAMICS IN THREE PROVINCES OF THE LOWLANDS OF NEPAL*

LAND USE LAND COVER CHANGES IN THE MAJOR CITIES OF NEPAL FROM 1990 TO 2020

FOREST FIRE PATTERN AND VULNERABILITY MAPPING USING DEEP LEARNING IN NEPAL

CHARACTERIZATION OF FOREST ECOSYSTEMS IN THE CHURE (SIWALIK HILLS) LANDSCAPE OF NEPAL HIMALAYA AND THEIR CONSERVATION NEED

INDIA *GLACIAL LAKE OUTBURST FLOOD RISK ASSESSMENT USING REMOTE SENSING AND HYDRODYNAMIC MODELING: A CASE STUDY OF SATLUJ BASIN, WESTERN HIMALAYAS, INDIA.*

A COMPREHENSIVE INSIGHT INTO WASTE TO ENERGY CONVERSION STRATEGIES IN INDIA AND ITS ASSOCIATED AIR POLLUTION HAZARD

PROBABLE MAXIMUM PRECIPITATION ANALYSIS OF HIGH RAINFALL REGIONS IN INDIA

CHINA *MODULATION EFFECT OF ANNUAL CYCLE ON INTERDECADAL WARMING TRENDS OVER THE TIBETAN PLATEAU DURING 1998-2020*

INSIGHTS INTO ALPINE-KARST-TYPE TUSA DEPOSITS IN GEOLOGICAL ENVIRONMENTAL RECORDS: A CASE STUDY OF THE CALCAREOUS TUSA PROFILE OF THE JIUZHAIGOU NATURAL RESERVE ON THE EASTERN MARGIN OF THE TIBETAN PLATEAU

MSCANET: MULTISCALE CONTEXT INFORMATION AGGREGATION NETWORK FOR TIBETAN PLATEAU LAKE EXTRACTION FROM REMOTE SENSING IMAGES

FREING ANIMALS: SINO-TIBETAN BUDDHIST ENVIRONMENTALISM AND ECOLOGICAL CHALLENGES

BHUTAN *SUSTAINABLE DEVELOPMENT IMPLICATIONS OF HUMAN WILDLIFE CONFLICT: AN ANALYSIS OF SUBSISTENCE FARMERS IN BHUTAN*

PAKISTAN *HYDROLOGICAL AND ECOLOGICAL IMPACTS OF RUN OFF RIVER SCHEME; A CASE STUDY OF GHAZI BAROTHA HYDROPOWER PROJECT ON INDUS RIVER, PAKISTAN*

UNDERSTANDING LOCAL ECOSYSTEM DYNAMICS IN THREE PROVINCES OF THE LOWLANDS OF NEPAL

Hari Prasad Pandey, Kishor Aryal, Suman Aryal, and Tek Narayan Maraseni

Science of The Total Environment 867: 161501

Incidences of failure of sustainable ecosystem management policies, especially in the developing world are partly attributable due to a lack of political will and inadequate understanding of ecosystem dynamics (ED) at the local levels. In this study, we endeavor to comprehend the dynamics of two ecosystems – forest and agriculture – by employing a resource-friendly participatory approach based on stake-taking the experiences of indigenous and forest-dependent local stakeholders in three lowland provinces of Nepal and is guided by the theory of socio-ecological concept. An in-depth survey (n = 136) was conducted using semi-structured questionnaires, key informant interviews (n = 9), and focus group discussions (n = 4) for data generation, and generalized linear models were used to test whether understanding of ED is uniform across the socio-ecological landscape. We identified that various attributes of forests and agricultural ecosystems have altered substantially earlier than 30 years (hereafter, earlier decade) relative to the present (hereafter, later decade). Apart from the natural processes including anthropogenic and climatic factors, technological innovations played a significant role in altering ecosystems in the later decade. Understanding of ED among forest-dependent stakeholders significantly varied with respect to gender, occupation, age group, gender-based water fetching responsibility, and water-fetching duration, however, no significant correlation was observed with their level of education across the landscape. The studied ecosystem attributes significantly correlate with water regime changes, signifying that water-centric ecosystem management is crucial. The attributes that observed significant dynamics in the forest ecosystem include changes in forest cover, structure and species composition, the severity of invasive species, wildfires, water regimes, and abundance and behavioral changes in mammals and avifauna. The alteration of crop cultivation and harvesting season which results in a decrease in yield, increased use of chemicals (fertilizers and pesticides), an increase in fallow land, and the proliferation of hybrid variety cultivation in the later decade are significant disparities in the dynamics of the agriculture ecosystem. To withstand the accelerated ED, stakeholders adopt various strategies, however, these strategies are either obtained from unsustainable sources entail high costs and technology, or are detrimental to the ecosystems. In relation, we present specific examples of ecosystem attributes that have significantly experienced changes in the later decade compared to the earlier decades along with plausible future pathways for policy decisions sustaining and stewardship of dynamic ecosystems across the socio-ecological landscape.

For further reading: <https://doi.org/10.1016/j.scitotenv.2023.161501>

LAND USE LAND COVER CHANGES IN THE MAJOR CITIES OF NEPAL FROM 1990 TO 2020

Praval Devkota, Sameer Dhakal, Sujata Shrestha, and Uttam Babu Shrestha

Environmental and Sustainability Indicators 17: 100227

Nepal—one of the most rapidly urbanizing countries in the world—has witnessed unplanned urbanization in recent decades. Nevertheless, spatial-temporal dynamics of land use land cover (LULC) in major cities of Nepal are not well understood. This study investigates LULC changes in the 12 rapidly urbanizing cities of Nepal from 1990 to 2020. Freely accessible Landsat images and Google Earth Engine (GEE), a cloud-based analysis platform were used to classify the city landscape into five major classes: vegetation, agriculture, barren, water body, and built-up using a random forest algorithm. Built-up areas have continuously increased in the Nepali cities mostly at expense of agricultural lands thus agriculture areas have decreased, and vegetation areas have followed mixed trends during each of the three decades. Biratnagar, Janakpur, Kathmandu, Nepalgunj, and Rajbiraj showed an overall increase in built-up areas at the expense of vegetation and agricultural lands while Bharatpur, Birendranagar, Dhangadhi, Ghorahi, Hetauda, Pokhara, and Tulsipur showed an overall decrease in agricultural areas with increased built-up areas and vegetation from 1990 to 2020. This study will assist the policymakers, city planners, and local governments to formulate sustainable urban development strategies

and plans to prevent haphazard urban growth while preserving the city's agricultural lands to promote local food supply and green areas to ensure an uninhibited flow of ecosystem services in the cities.

For further reading: <https://doi.org/10.1016/j.indic.2023.100227>

FOREST FIRE PATTERN AND VULNERABILITY MAPPING USING DEEP LEARNING IN NEPAL

Bhogendra Mishra, Saroj Panthi, Shobha Poudel, and Bhoj Raj Ghimire

Fire Ecology 19: 3

In the last two decades, Nepal has experienced an increase in both forest fire frequency and area, but very little is known about its spatiotemporal dimension. A limited number of studies have researched the extent, timing, causative parameters, and vulnerability factors regarding forest fire in Nepal. Our study analyzed forest fire trends and patterns in Nepal for the last two decades and analyzed forest fire-vulnerability risk based on historical incidents across the country.

We analyzed the spatial and temporal patterns of forest fires and the extent of burned area using the Mann-Kendall trend test and two machine-learning approaches maximum entropy (MaxEnt), and deep neural network (DNN). More than 78% of the forest fire burned area was recorded between March and May. The total burned area has increased over the years since 2001 by 0.6% annually. The forest fire-vulnerability risk obtained from both approaches was categorized into four classes—very high, high, low, and very low.

Although burned area obtained from both models was comparable, the DNN slightly outperformed the MaxEnt model. DNN uses a complex structure of algorithms modeled on the human brain that enables the processing of the complex relationship between input and output dataset, making DNN-based models recommended over MaxEnt. These findings can be very useful for initiating and implementing the most suitable forest management intervention.

For further reading: <https://doi.org/10.1186/s42408-022-00162-3>

CHARACTERIZATION OF FOREST ECOSYSTEMS IN THE CHURE (SIWALIK HILLS) LANDSCAPE OF NEPAL HIMALAYA AND THEIR CONSERVATION NEED

Yadav Uprety, Achyut Tiwari, Sangram Karki, Anil Chaudhary, Ram Kailash Prasad Yadav, Sushma Giri, Srijana Shrestha, Kiran Paudyal, and Maheshwar Dhakal

Forests 14: 100

As a basic component of the forest ecosystem, the forest structure refers to the general distribution of plant species of different life forms and sizes. The characterization of forest structure is the key to understanding the vegetation history, present status, and future development trajectory of the forest ecosystems. The Chure region of Nepal covers about 12.78% of the country's land area and extends east to west along the southern foothills. This biologically rich but geologically fragile region is home to many species and provides many ecosystem services to millions of people. The Chure landscape is severely suffered from anthropogenic disturbances including logging, grazing, fuelwood collection, solid waste disposal, encroachment, forest fire, and excavation of sand, gravel, and boulders. In this study, we aim to characterize the forest ecosystem types outside the protected areas in the Chure region of Nepal and analyze the threat and vulnerability of the landscape from the biodiversity point of view. We sampled 62 sites to study the dominant vegetation type, regeneration status, and major threats to the forest ecosystems. A distribution map of the forest ecosystem types in Chure was prepared. We identified 14 forest ecosystem types in Chure including seven new ones. The newly reported forest ecosystems are *Hymenodictyon excelsum* Forest, *Syzygium cumini* Forest, *Terminalia anogeissiana* Forest, *Schima wallichii–Shorea robusta* Forest, *Pinus roxburghii–Shorea robusta* Forest, *Pinus roxburghii* Forest, and Bamboo thickets. We conclude that intensified human activities including forest encroachment and deforestation are mainly responsible for the ecological imbalance in the Chure region. We emphasize an in-depth analysis of biophysical linkage and immediate conservation efforts for the restoration of the Chure landscape in Nepal.

For further reading: <https://doi.org/10.3390/f14010100>

India-Himalaya

GLACIAL LAKE OUTBURST FLOOD RISK ASSESSMENT USING REMOTE SENSING AND HYDRODYNAMIC MODELING: A CASE STUDY OF SATLUJ BASIN, WESTERN HIMALAYAS, INDIA

Manish Rawat, Sanjay Kumar Jain, Rayees Ahmed, and Anil Kumar Lohani

Environmental Science and Pollution Research 30: 1-18

Glacier-associated hazards are becoming a common and serious challenge to the high mountainous regions of the world. Glacial lake outburst floods (GLOFs) are one of the most serious unanticipated glacier hazards, with the potential to release a huge amount of water and debris in a short span of time, resulting in the loss of lives, property, and severe damage to downstream valleys. The present study used multi-temporal Landsat and Google earth imageries to analyze the spatio-temporal dynamism of the selected glacial lake (moraine-dammed) in the Satluj basin of Western Himalayas. Furthermore, GLOF susceptibility of the lake was assessed using a multi-criteria decision-based method. The results show that the lake area has increased from 0.11 to 0.26 km² over the past 28 years from 1990 to 2018. The susceptibility index value for the lake was calculated as 0.75, which indicates that the lake is highly susceptible to the GLOF. The depth and volume of the lake were estimated to be 16 m and 57×10^5 m³, respectively, using an empirical formula. HEC-RAS, HECGeo-RAS, and Arc-GIS software were utilized in this study to perform unsteady flow analysis and to determine the GLOF impact on the downstream area. The worst-case GLOF scenario (breach width of 75 m) was revealed during an overtopping failure of the moraine dam, resulted in a peak discharge of 4060 m³/s and releasing a total water volume of 57×10^5 m³. The breach hydrograph has been routed to calculate the spatial and temporal distribution of peak flood, inundation depth, velocity, water surface elevation, and flood peak arrival time along the river channel. The analysis further reveals that the routed flood waves reach the nearest settlement, i.e., Rajpur town, situated at a distance of 102 km in the downstream valley of the lake at 6 h after the beginning of the lake breach event with a peak discharge/flood of 1757 m³/s and maximum flow velocity of 1.5 m/s. With the ongoing climate warming and glacier retreat, moraine-dammed lakes are becoming more hazardous and thus increasing the total threat. Therefore, it is mandatory to monitor and assess such lakes at regular intervals of time to lessen the disastrous impacts of GLOFs on the livelihood and infrastructure in the downstream valleys. The findings of this study will aid in the creation of risk management plans, preparatory tactics, and risk reduction techniques for GLOF hazards in the region.

For further reading: <https://doi.org/10.1007/s11356-023-25134-1>

A COMPREHENSIVE INSIGHT INTO WASTE TO ENERGY CONVERSION STRATEGIES IN INDIA AND ITS ASSOCIATED AIR POLLUTION HAZARD

Arijeet Karmakar, Trisha Daftari, Sivagami K., Mohammed Rehaan Chandan, Aabid Hussain Shaik, Bandaru Kiran, and Samarshi Chakraborty

Environmental Technology & Innovation 29: 103017

With the increasing demand for cheap energy sources, Waste-to-Energy (WtE) strategies are gaining importance across the world. In India, such strategies have a two-way benefit i.e., generating electricity using municipal solid waste and helping in solid waste management by reducing the need for landfill sites. In this review, the focus has been given to identifying and analysing toxicological problems related to major air pollutants emitted during the WtE conversion process. Depending upon the country and state, the nature of solid waste and emission standards vary which directly impacts air quality standards and steps required to reduce such emissions. In India, the percentage of wet solid waste is much higher than dry solid waste which

significantly deters the economic and technical feasibility of WtE plants. The heating value of solid waste reduces significantly when improper waste segregation occurs which is detrimental from both the electricity generation and pollution viewpoint. These problems associated with solid waste management have been covered in detail in the manuscript. This review article also provides a comparative study of Indian WtE plants with their global specifically European counterparts. The adverse effect of pollutants emitted from WtE plants on human health has been discussed in the article along with the air pollution control methods to mitigate the problem. To gauge the importance and limitation of WtE plants over conventional solid waste management strategies such as landfills, the environmental impact assessment has also been discussed which further justifies the necessity of the present article.

For further reading: <https://doi.org/10.1016/j.eti.2023.103017>

PROBABLE MAXIMUM PRECIPITATION ANALYSIS OF HIGH RAINFALL REGIONS IN INDIA

Durga Prasad Panday, Akansha Singh, Siddhant, Aditya Ketu, Raja, Asok Raja S K, and Manish Kumar

Groundwater for Sustainable Development 21: 100893

Uttarakhand, Maharashtra, Assam & Meghalaya are the potential areas to study the precipitation, perform trend analysis and calculate the probable maximum precipitation. Probable Maximum Precipitation (PMP) has virtually zero risk of being exceeded for a given catchment area over a certain duration of time. The present work applies Hershfield Method to determine the PMP for rainfall data for the high rainfall regions of Uttarakhand, Maharashtra, Assam & Meghalaya (Assam and Meghalaya are considered as one region). Gumbel method, which is an extreme value distribution function is used to obtain the extreme value (EV) of precipitation. Further, the obtained PMP and EV values are compared with high rainfall months of La Niña years. Observation of the results showed that the obtained values from Hershfield Method are greater than the La Niña years precipitation values that have been observed till 2017, thus validating the obtained results. The outcomes from Probable Maximum Precipitation (PMP) works give insights into the extreme rainfall that can ever happen in a given catchment. The result obtained serves as indispensable input data for designing structures like dams, reservoirs, spillways, flood protection walls, sluice gates, weirs, etc. The design life of hydraulic structures is worked out using Probable Maximum Precipitation (PMF). The adopted technique and results of this study can be directly used as a design parameter for design as well as for water resources management.

For further reading: <https://doi.org/10.1016/j.gsd.2022.100893>

China Himalaya

MODULATION EFFECT OF ANNUAL CYCLE ON INTERDECADAL WARMING TRENDS OVER THE TIBETAN PLATEAU DURING 1998-2020

Zhengkun Qin and Xiaolei Zou

Journal of Climate 36: 1-34

Tibetan Plateau is a sensitive area of global climate change, where a few conventional observations exist. Satellite AMSU-A microwave temperature sounding observations of brightness temperature (TB) are located in the absorption band of oxygen, which is well mixed in the atmosphere, and have microwave frequencies varying from 50.3 to 57.6 GHz. Therefore, AMSU-A TB observations at different sounding channels reflect atmospheric temperatures at different altitudes. In this study, AMSU-A TB observations during 1998-2020 from five polar-orbiting environmental meteorological satellites (POESs) are employed to investigate the interdecadal warming/cooling trends over the Tibetan Plateau. A limb correction is firstly applied to all AMSU-A channels before using TB observations at all fields-of-views for examining geographic distributions and differences of global warming/cooling trends. It is found that interdecadal trends of upper tropospheric warming and stratospheric cooling are stronger over the Qinghai Tibetan Plateau than its eastern plain areas.

An interdecadal variation of annual cycle over the Tibetan plateau is an important factor for the enhanced tropospheric warming trend. We also applied a different approach of significance testing that is based on counting signs of local trends (sign test) and confirmed that the detected significant local trends were not a result of chance. In addition, high-frequency noise in TB observations with periods smaller than annual and semi-annual oscillations do not affect the climate trends of TB very much, but significantly reduced the uncertainty of the TB trends over the Tibetan Plateau.

For further reading: <https://doi.org/10.1175/JCLI-D-22-0517.1>

INSIGHTS INTO ALPINE-KARST-TYPE TUFA DEPOSITS IN GEOLOGICAL ENVIRONMENTAL RECORDS: A CASE STUDY OF THE CALCAREOUS TUFA PROFILE OF THE JIUZHAIGOU NATURAL RESERVE ON THE EASTERN MARGIN OF THE TIBETAN PLATEAU

Congcong Lv, Xueqin Zhao, Yaoxi Jiang, Heyan Zhu, Hongmin Zhang, Fudong Wang, Qiongfang Li, and Keli Hou

Minerals 13: 120

To study the geological environmental records of alpine-karst-type tufa deposits in the eastern margin of the Tibetan Plateau, the calcareous tufa profile exposed by the “8.8” Jiuzhaigou earthquake was taken as the research object and combined with a field geological investigation. Further, the petrography, sedimentology, chronology, and elemental geochemistry of the calcareous tufa were studied and analyzed. The results show the following. (1) The Sparkling Lake calcareous tufa profile was deposited under the background of a warm and humid climate during the Holocene. The growth pattern follows a bottom-to-top deposition. (2) At 750 ± 30 – 300 ± 30 a.B.P., the calcareous tufa layers were gray-black as a whole, and the changes in mineral composition and elemental geochemistry indicate a fluctuating upward trend for temperature and precipitation during this period. (3) The formation of two sets of black peat layers in the upper part of the tufa calcareous profile is due to the synergistic action of multiple factors caused by strong tectonic activity. In conclusion, the deposition mechanism of the calcareous tufa in Jiuzhaigou was controlled by paleoclimate hydrology and glaciation for a long time, while strong tectonic activity over a short period of time considerably changed the color, structure, element content, and mineral composition of the calcareous tufa.

For further reading: <https://doi.org/10.3390/min13010120>

MSCANET: MULTISCALE CONTEXT INFORMATION AGGREGATION NETWORK FOR TIBETAN PLATEAU LAKE EXTRACTION FROM REMOTE SENSING IMAGES

Zhihui Tian, Xiaoyu Guo, Xiaohui He, Panle Li, Xijie Cheng, and Guangsheng Zhou

International Journal of Digital Earth 16: 1-30

Qinghai-Tibet Plateau lakes are important carriers of water resources in the ‘Asian’s Water Tower’, and it is of great significance to grasp the spatial distribution of plateau lakes for the climate, ecological environment, and regional water cycle. However, the differences in spatial-spectral characteristics of various types of plateau lakes, and the complex background information of plateau both influence the extraction effect of lakes. Therefore, it is a great challenge to completely and effectively extract plateau lakes. In this study, we proposed a multiscale contextual information aggregation network, termed MSCANet, to automatically extract Plateau lake regions. It consists of three main components: a multiscale lake feature encoder, a feature decoder, and a Multicore Pyramid Pooling Module (MPPM). The multiscale lake feature encoder suppressed noise interference to capture multiscale spatial-spectral information from heterogeneous scenes. The MPPM module aggregated the contextual information of various lakes globally. We applied the MSCANet to the lake extraction of the Qinghai-Tibet Plateau based on Google data; additionally, comparative experiments showed that the MSCANet proposed had obvious improvement in lake detection accuracy and morphological integrity. Finally, we transferred the pre-trained optimal model to the Landsat-8 and Sentinel-2A dataset to verify the generalization of the MSCANet.

For further reading: <https://doi.org/10.1080/17538947.2022.2159552>

FREING ANIMALS: SINO-TIBETAN BUDDHIST ENVIRONMENTALISM AND ECOLOGICAL CHALLENGES

Dan Smyer Yü

Religions 14: 110

Buddhist environmentalism in its varieties across the world is an integral part of the global environmental discourse centered on exploring new planetary ethics for sustainable futures. While recognizing the Buddhist role in global environmental movements, the author of this article proposes that the observable strength of Buddhist environmentalism is in local and global environmental advocacy grounded in the Buddhist ethics of interdependence, even as, canonically, Buddhism does not offer what is commonly recognized by scientists and scholars as traditional ecological knowledge or religious ecology. To substantiate this, this article offers a textual assessment of the Buddhist canon's lack of systematic ecological knowledge, and a case study of how freeing domestic animals and advocating vegetarianism among contemporary Tibetan Buddhists in China, inclusive of non-Tibetan converts, mainly benefits human wellbeing and at the same time is entangled in social affairs that have little to do with the ecological wellbeing of the Tibetan Plateau and urban China. This debate is by no means intended to negate the successes of Buddhist environmentalism; instead, it draws fine lines between the claimed canonic basis of Buddhist ecology, the strength of Buddhist environmental advocacy, the everyday practices of Buddhism, and the aspirations for strengthening the ecological foundation of Buddhist environmental activism. Thinking in line with eco-Buddhists, the author concludes the article by proposing an Earth Sutra, a hypothetical future canonic text as the ecological basis of Buddhist environmentalism.

For further reading: <https://doi.org/10.3390/rel14010110>

Bhutan-Himalaya

SUSTAINABLE DEVELOPMENT IMPLICATIONS OF HUMAN WILDLIFE CONFLICT: AN ANALYSIS OF SUBSISTENCE FARMERS IN BHUTAN

Yeshey, Rodney J. Keenan, Rebecca M. Ford, and Craig R. Nitschke

International Journal of Sustainable Development & World Ecology 30: 1-6

Sustainable Development Goals (SDGs) are part of 2030 Agenda for Sustainable Development (SD) that aim to eradicate poverty, achieve economic prosperity, gender equality, ensure social well-being, promote sustainable management and use of natural resources, and protect the Earth's natural ecosystems. However, the occurrence of human-wildlife conflict (HWC) may impair SDGs to be achieved in developing regions where people and wildlife cooccur frequently. Surprisingly, there are few studies which have examined how HWC impedes achievement of SDGs. This paucity of information hinders the formulation and implementation of appropriate policy actions to achieve SDGs. We explored how HWC impacts on the livelihoods of rural communities in Bhutan through SD lens. We used a mixed method research approach and interviewed a stratified-random sample of 96 farmers from four different regions of Bhutan. Wildlife impacts are multidimensional and can inhibit achievement of several SDGs. All interviewees suffered crop and livestock depredations with substantial economic losses. These losses were higher for female-headed households and those with low asset holding, compounding their vulnerability. Among the HWC adaptation measures, adopted guarding, vigilant livestock herding, and electric fences were perceived effective but were predominantly applied by households in high asset class. Policy actions should focus on female-headed households and those families with lower asset category to reduce negative impacts of human wildlife interactions.

For further reading: <https://doi.org/10.1080/13504509.2023.2167242>

Pakistan-Himalaya

HYDROLOGICAL AND ECOLOGICAL IMPACTS OF RUN OFF RIVER SCHEME; A CASE STUDY OF GHAZI BAROTHA HYDROPOWER PROJECT ON INDUS RIVER, PAKISTAN

Ehsan Inam Ullah, Shakil Ahmad, Muhammad Fahim Khokhar, Muhammad Azmat, Umer Khayyam, and Faizan ur Rehman Qaiser

Heliyon 9: e12659

Run off river schemes are getting widespread importance as they are considered environmentally safe. However, number of studies and the consequent information regarding impacts of run off river schemes is very limited worldwide. Present study attempted to analyze impacts of Ghazi Barotha Hydropower Plant, which is a run off river scheme situated in Khyber Pakhtunkhwa province of Pakistan. This study attempted to analyze impacts of this run off river scheme on hydrological and ecological conditions of downstream areas. Data on river discharge, groundwater levels, agriculture area, vegetation and bare soil was utilized for this study. All data sets between the year 1990 till 2020 were analyzed. Hydrological impacts were analyzed through secondary data analysis, whereas ecological impacts were studied through remote sensing technique. Statistical methods were applied to further draw conclusions between hydrological and ecological interrelationships. Results showed that after functioning of Ghazi Barotha, there was 47% and 91% reduction of river discharge, in summer and winter seasons respectively. Groundwater level dropped by 50%. Agriculture area reduced by 1.69% and 9.11% during summer and winter respectively, whereas land under bare soil increased. River water diversion was considered to be responsible for groundwater reduction, as strong correlation was found between both. Agriculture land recovery, in post Ghazi Barotha period, was premised at intense groundwater mining, as groundwater level and agriculture area were significantly related ($p < 0.05$). Governments' groundwater development schemes, and a shift into motorized groundwater mining were major factors behind further groundwater exploitation in study area. This study came to the conclusion that Ghazi Barotha Hydropower Plant had impacted flow regime of Indus River, as well as groundwater levels and land use of downstream area along the river. These effects were triggered by inappropriate compensatory measures and uncontrolled water resource exploitation.

For further reading: <https://doi.org/10.1016/j.heliyon.2022.e12659>