For the 669th - 670th issues of Headlines Himalaya, we reviewed researches from four sources and selected 18 researches from four countries. We selected one research from Nepal and 17 researches from other Himalayan countries (India, China, and Pakistan).

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ENVIRONMENTAL COMPLIANCE OF HYDROPOWER PROJECTS IN NEPAL

Hemant R Ghimire, Sunita Phuyal, and Nabin R Singh

Environmental Challenges 5: 100307

The construction of hydropower projects is proliferating, and environmental studies are conducted to make them more environmental-friendly. As properly managed hydropower projects have minimal environmental impacts, the environmental compliance of the projects should be assessed to know whether they are properly managed. However, the environmental compliance of the hydropower projects has not been adequately evaluated. To understand such compliance, we assessed the implementation status of the mitigation measures proposed in the approved environmental study reports of the hydropower projects of Nepal as a case study. We studied eight hydropower projects, of which three were under-construction, and five were operated projects. We found that about three-fourths of the mitigation measures are partially or fully implemented in hydropower projects. There are no substantial differences in the environmental compliance between operated and under-construction hydropower projects. We found that socio-economic and cultural environment-related mitigation measures are mostly implemented in hydropower projects. However, there are some major environmental non-compliance of hydropower projects in the physical and biological environment, which can severely undermine the environmental performance of the hydropower projects. As hydropower projects are necessary for reducing the negative impacts of fossil fuels in Nepal and the global context, these mitigation measures should be implemented to make them more environment-friendly. We recommend frequent inspection and monitoring and other measures that should be urgently applied to increase the environmental compliance of hydropower projects. Similarly, further research on the reason behind the non-compliance, the effectiveness of the mitigation measures, and ways to improve the compliance rate should be carried out.

For further reading: https://doi.org/10.1016/j.envc.2021.100307

HUMAN HEALTH RISK ASSESSMENT USING MONTE CARLO SIMULATIONS FOR GROUNDWATER WITH URANIUM IN SOUTHERN INDIA

RamyaPriya Ramesh, Manoj Subramanian, Elango Lakshmanan, Anbarasu Subramaniyan, and Gowrisankar Ganesan

Uranium naturally occurs in groundwater and its concentration is mostly controlled by the geology of an area**.** The regular human consumption of groundwater with uranium causes health effects and hence the assessment of radiological and chemical toxicity effects on humans is essential. Hence, the present study was carried out to assess the general hydrochemistry of groundwater in different geological formations of southern India and its relation to uranium as well as to estimate the health risks posed to humans due to consumption of groundwater with uranium using both deterministic and probabilistic approaches. Four river basins representing the major geological formations of southern India were chosen for this study, from where a total of 141 groundwater samples were collected in the year 2016 and analyzed for the concentration of major ions and uranium. The groundwater occurring in granites had high concentration of uranium followed by gneiss and charnockites. Radiological risks to humans were higher in granitic terrain of Bhima basin, where about 1 in 10,000 may get affected due to cancer. The chemical toxicity risks were higher for the people in granite and gneissic terrain of Bhima basin followed by the people in charnockite terrain of Vaniyar basin. The deterministic method has overestimated the actual risk in comparison to the probabilistic risk assessment. The sensitivity analysis indicates that increase of exposure frequency and ingestion rates increases the chemical risks, whereas decrease of body weight increases the chemical risk. Therefore, the probabilistic approach is much superior to deterministic method since it exhibits variability in the values. The current study highlights the risks to humans by consuming groundwater with uranium, emphasizing on the urgent need for supplying treated water to the community.

For further reading: https://doi.org/10.1016/j.ecoenv.2021.112781

SPATIO-TEMPORAL PATTERN OF CHANGE IN MANGROVE POPULATIONS ALONG THE COASTAL WEST BENGAL, INDIA

Biswajit Mondal, Ashis Kumar Saha, and Anirban Roy

Mangrove forests in many parts of the world are declining at an alarming rate, which intensifies vulnerability in coastal ecosystems. An area like coastal West Bengal, including the Sundarban delta, where the world's largest mangrove populations have flourished, has a substantial negative impact of anthropogenic pressure since the early 15th-16th century. Frequent coastal hazards, sea-level rise, and ever-increasing anthropogenic pressure have complicated the growth and regeneration of mangroves. In this study, an attempt has been made to map the patches of mangrove available in the coastal region of West Bengal along with their spatio-temporal, zonal pattern of change and probable reasons for those changes. The study approaches have been achieved by the analysis of Landsat data using several buffer zones from the coastline during 1989-2018 through geospatial techniques. The

result indicates that despite a reduction of mangrove populations in the pre-and post-colonial era, overall mangrove areas have a marginally positive growth of about 0.47% (68.06 sq. km) of the total area during the assessment period. Although the mangrove area along the shoreline is decreasing faster, many new mangrove patches have appeared towards the mainland. Simultaneously, mangrove areas are encroached in the northern periphery of Sundarban Biosphere Reserve to convert them into settlements, agriculture, and aquaculture. This study could help to protect mangrove populations and implement appropriate conservation measures.

For further reading: https://doi.org/10.1016/j.envc.2021.100306

China Himalaya

INDIVIDUAL EXPOSURE TO AMBIENT $PM_{2.5}$ AND HOSPITAL ADMISSIONS FOR COPD IN 110 HOSPITALS: A CASE-CROSSOVER STUDY IN GUANGZHOU, CHINA

Jie-Qi Jin, Dong Han, Qi Tian, Zhao-Yue Chen, Yun-Shao Ye, Qiao-Xuan Lin, Chun-Quan Ou, and Li Li

Environmental Science and Pollution Research 28: 1-8

Few studies have evaluated the short-term association between hospital admissions and individual exposure to ambient particulate matter ($PM_{2.5}$). Particularly, no studies focused on hospital admissions for chronic obstructive pulmonary disease (COPD) at the individual level. We assessed the short-term effects of $PM_{2.5}$ on hospitalization admissions for COPD in Guangzhou, China, during 2014–2015, based on satellite-derived estimates of ambient $PM_{2.5}$ concentrations at a 1-km resolution near the residential address as individual-level exposure for each patient. Around 40,002 patients with COPD admitted to 110 hospitals were included in this study. A time-stratified case-crossover design with conditional logistic regression models was applied to assess the effects of $PM_{2.5}$ based on a 1-km grid data of aerosol optical depth provided by the National Aeronautics and Space Administration on hospital admissions for COPD. Further, we performed stratified analyses by individual demographic characteristics and season of hospital admission. Around 10 μg/m3 increase in individual-level $PM_{2.5}$ was associated with an increase of 1.6% (95% confidence interval [CI]: 0.6%, 2.7%) in hospitalization for COPD at a lag of 0–5 days. The impact of $PM_{2.5}$ on hospitalization for COPD was greater significantly in males and patients admitted in summer. Our study strengthened the evidence for the adverse effect of $PM_{2.5}$ based on satellite-based individual-level exposure data.

For further reading: https://doi.org/10.1007/s11356-021-16539-x

ADAPTATION STRATEGIES AND LAND PRODUCTIVITY OF BANANA FARMERS UNDER CLIMATE CHANGE IN CHINA

Yueji Zhu, Qi Yang, and Cheng Zhang

Climate Risk Management 34: 100368

Climate change has become a key challenge to land productivity in developing countries. Adaptation strategies can increase farmers' resilience to climate change in agricultural production. Many studies have explored how farmers adapted to climate change on the underlying premise that they homogeneously have a complete knowledge about climate change adaptation strategies. However, the knowledge of smallholder farmers can be incomplete and heterogeneous particularly under climatic shocks. And the role of social network in farmers' adaptation decisions cannot be neglected. We specify social network into formal social tie (cooperative membership), and informal

social tie (to local farmers and agricultural input retailers). This paper is the first attempt to examine the heterogeneous impact of social ties on farmers' adaptation decisions, and further assess the effect of adaptation strategies on land productivity under climate change using Augmented Inverse Probability Weights (AIPW) estimator, based on the primary data collected from banana farmers in China. The results show that 55 percent of banana farmers adopted adaptation strategies to mitigate the impact of climate change in farming practices. Out of eight coping strategies, diversifying crops, increasing chemical use, increasing irrigation and planting trees were prioritized measures used by banana farmers. Both formal and informal social ties of farmers exerted a significant impact on farmers' adaptation decisions. Participation in agricultural cooperatives and tie to agricultural input retailers increased farmers' uptake rate of adaptation strategies. In contrast, tie to local farmers hindered farmers from taking active actions to combat climate change. We also found that the adaptation strategies significantly increased the land productivity of banana farmers. Interestingly, the land productivity of adopters was more influenced by the formal social tie (cooperative membership); while the informal social tie (to agricultural input retailers) affected that of non-adopters. These findings highlight the importance of different social ties of smallholder farmers in making policy package to increase their responses to climate change and improve land productivity in developing regions.

For further reading: https://doi.org/10.1016/j.crm.2021.100368

EFFECTS OF LONG-TERM NITROGEN ADDITION ON DISSOLVED ORGANIC MATTER CHARACTERISTICS IN A TEMPERATE WETLAND OF NORTHEAST CHINA

Yi-Dong Ding, Chang-Chun Song, Guang-Jiao Chen, Xin-Hou Zhang, and Rong Mao

Dissolved organic matter (DOM) plays an indispensable role in ecosystem services and functions in wetlands. While most wetlands have undergone increased nitrogen (N) loading due to intensive human activities, the response of DOM characteristics to long-term N addition remains unexplored. In this study, we assessed the changes in dissolved organic carbon (DOC), NH_4^+, NO_3^-, dissolved organic N (DON), dissolved total N (DTN), and dissolved total phosphorus (DTP) in surface water and soil pore water at 15 cm depth after 10 years of N addition at four levels (0, 60, 120, and 240 kg N hm^{-2} $year^{-1}$) in a freshwater marshof Northeast China. We also examined the effect of N addition on DOM aromaticity and humification by measuring the specific UV absorbance at 254 nm ($SUVA_{254}$), the color per C unit (C/C ratio), and the fulvic acid/humic acid ratio (E4/E6 ratio). Our results showed that N addition significantly altered DOM properties, but the direction and magnitude of these changes generally did not vary with the N addition level. During the growing season, DOC, NH_4^+, NO_3^-, DON, and DTN concentrations in both surface water and soil pore water were increased by N addition. Accordingly, N addition increased the DOC/DTP and DTN/DTP ratios but decreased the DOC/DTN ratio in surface water and soil pore water. In addition, the $SUVA_{254}$ value and C/C ratio increased, while the E4/E6 ratio reduced after N addition in surface water and soil pore water, indicating increases in DOM aromaticity and humification. These observations suggest that long-term N addition changes DOM characteristics by causing stoichiometric imbalances and increasing recalcitrant compounds in temperate freshwater wetlands, which may then deteriorate water quality, alter microbial-mediated ecological processes, and impact downstream aquatic ecosystem structures.

For further reading: https://doi.org/10.1016/j.ecoenv.2021.112822

BIOCHAR ENHANCES THE RETENTION CAPACITY OF NITROGEN FERTILIZER AND AFFECTS THE DIVERSITY OF NITRIFYING FUNCTIONAL MICROBIAL COMMUNITIES IN KARST SOIL OF SOUTHWEST CHINA

Meng Zhang, Yanling Liu, Quanquan Wei, and Jiulan Gou

Biochar is usually used as an agricultural soil amendment to improve soil nutrition availability and soil microbial environment. However, the effects of Moutai lees biochar on the migration and retention characteristics of nitrogen fertilizer and the changes of nitrifying microorganisms on yellow soil of southwest China are still not distinct. In this study, the migration distribution characteristics of nitrogen fertilizer, nitrogen retention capacity and microbial community structure were evaluated by a soil column leaching simulated experiment. Five application rates of biochar: 0%(BC_0), 0.5%($BC_{0.5}$), 1.0%($BC_{1.0}$), 2.0%($BC_{2.0}$) and 4.0%($BC_{4.0}$) were respectively tried. The results showed that the application of Moutai lees biochar has significantly increased the total nitrogen (TN) and nitrate (NN) contents in yellow soil, but it has also significantly decreased the microbial biomass nitrogen (MBN) content. When compared with the BC_0 treatment, it was found that the application of biochar increased nitrogen fertilizer retention rate (N_F) to 49.84%–95.23%. Moreover, high biochar application rates (2.0% and 4.0%) were also able to improve the N_F ratio, while low biochar application rates (0.5% and 1.0%) still had the risk of nitrogen leaching losses. Additionally, the application of biochar changed the bacterial community structure and the relative abundance of nitrogen-related microorganisms in yellow soil. Also, it was determined that Nitrite-oxidizing bacteria (NOB) played a major factor in affecting soil nitrogen, instead of ammonia-oxidizing archaea (AOA) and ammonium-oxidizing bacteria (AOB). Overall, research finally concluded that Moutai lees biochar decreased nitrite oxidation effect and changed ammoxidation to affect nitrogen nutrients availability in yellow soil and the biochar application rate of 4% has increased nitrogen fertilizer retention rate and decreased the risk of nitrogen leaching losses in yellow soil.

For further reading: https://doi.org/10.1016/j.ecoenv.2021.112819

CHANGES IN ENVIRONMENTAL WORLDVIEWS AMONG CHINESE URBAN RESIDENTS DURING ECONOMIC GROWTH AND ACCELERATING POLLUTING IN THE 2000s

Chenyang Xiao, Erik Kojola, and Yechao Fan

During the first decade of the 2000s, China experienced tremendous growth in the economy and environmental degradation. This study examines whether there has been a subsequent increase in pro-environmental worldviews among urban Chinese people over that period since theories predict that both greater affluence and exposure to pollution can promote such views. We find that from 2003 to 2010, Chinese urban citizens' pro-environmental worldviews measured by the New Environmental/Ecological Paradigm (NEP) did not increase as would be predicted by multiple theories, indicating that environmental concern is more complex and multi-faceted. Instead, we find some evidence for a diffusion process of environmental concern from more educated people to the rest of the population. We also argue that the impact of different facets of socioeconomic status on environmental concern matter as we find that education increases pro-environmental worldviews more than income.

For further reading: https://doi.org/10.1016/j.indic.2021.100152

IMPACTS OF REDUCING AIR POLLUTANTS AND CO$_2$ EMISSIONS IN URBAN ROAD TRANSPORT THROUGH 2035 IN CHONGQING, CHINA

Linfeng Duan, Wei Hu, Di Deng, Weikai Fang, Min Xiong, Peili Lu, Zhenliang Li, and Chongzhi Zhai

Environmental Science and Ecotechnology 8: 100125

The road transport sector in megacities is confronted with pressing local air pollution and carbon dioxide (CO$_2$) control issues. To determine effective policy instruments for saving energy and the co-control of air pollutants and CO$_2$, several mainstream measures were examined and compared in Chongqing's road transport sector from 2017 to 2035. An integration assessment framework was developed by combining the Long-range Energy Alternatives Planning (LEAP) system and a set of quantitative methods for evaluating the co-benefits of emission reductions (including the air pollutant equivalent (AP$_{eq}$), co-control coordinate system, and pollutant reduction cross-elasticity (Els$_{a/b}$)). Results showed that the shifting transportation modes scenario presented the most significant potential for energy-saving and emission reductions, reducing energy use by 30.9% and air pollutants and CO$_2$ emissions by approximately 27–32% compared with the business as usual (BAU) scenario in 2035. The improving energy efficiency scenario also provided significant co-benefits for reducing air pollutants and CO$_2$ emissions. Nevertheless, the promoting alternative fuel scenario may increase fine particulate matter (PM$_{2.5}$) emissions by 2.2% compared to BAU in 2035 under the cleanness of regional electricity in 2017. Our findings suggest that the shifting transportation modes were effective measures to reduce air pollutants and CO$_2$ in the short term synergistically, and highlighted the importance of cleaner electricity generation to develop electric vehicles in the medium and long term.

For further reading: https://doi.org/10.1016/j.ese.2021.100125

FUTURE RESEARCH NEEDS FOR ENVIRONMENTAL SCIENCE IN CHINA

Dongqiang Zhu, Weiqiang Chen, Xiaolei Qu, Yuming Zheng, Jun Bi, Haidong Kan, Yongming Luo, Guangguo Ying, Eddy Y. Zeng, Fangjie Zhao, Lingyan Zhu, Yongguan Zhu, and Shu Tao

Geography and Sustainability 2: 234-242

Environmental science is an interdisciplinary science developed in the process of understanding and solving ecological and environmental problems. In order to tackle these problems, environmental science research is expected to reveal the source, behaviour, fate, exposure, and risks of pollutants in the environment and develop potential solutions to control pollution. It provides the scientific basis for decision-makers to establish environmental and economic policies, and promote concerted efforts for the sustainable development of society. Here, we articulate the development patterns, challenges, and future research needs of environmental science in China based on literature review and expert panel discussion. Environmental science research has evolved significantly in the past decade with an increasing diversity of environmental pollutants and health impacts, new technologies and methods, deepening fusion of multiple disciplines, and emerging solutions for pollution control. Its future development relies on the advances in our knowledge on the fate and transport of pollutants, regional environmental processes, Eco toxicological effects, environmental exposure and health effects, environmental analysis and monitoring, source control and reduction, environmental remediation, as well as environmental risk management. For each of these fields, we summarize the significant challenges and highlight the research demands for China. Based on the status quo of China's environmental science research and future needs, we provide recommendations to promote its future development, including encouraging innovation and

interdisciplinary research, providing decision support for national needs, encouraging international collaboration, and improving collaboration mechanisms.

For further reading: https://doi.org/10.1016/j.geosus.2021.09.003

IMPACTS OF CLIMATE CHANGE ON BLUE AND GREEN WATER RESOURCES IN THE MIDDLE AND UPPER YARLUNG ZANGBO RIVER, CHINA

Junjun Huo, Xing Qu, Dejun Zhu, Zhe Yuan, and Yuanzhi Tang

The Yarlung Zangbo River is the largest river on the Tibetan Plateau and a major international river in South Asia. Changes in the blue and green water resources in its basin are of great importance to the surrounding local and Asian regions in the context of global warming. This research used the Soil and Water Assessment Tool model to estimate blue and green flows (BWF and GWF) and analyse the spatial-temporal distribution characteristics under different hypothetical climate change scenarios. The results show that (1) the multi-year average BWF in the middle and upper reaches of the Yarlung Zangbo River Basin is 176.2 mm, the GWF is 213.1 mm, and the difference between precipitation and total water resources is only 5.4 mm; (2) both BWF and GWF in this basin showed a slightly increasing trend from 1980 to 2010, but the distribution of sub basins from upstream to downstream is decreasing; and (3) GWF has a positive correlation with both precipitation and temperature, but BWF only increases with precipitation and decreases with increasing temperature. Moreover, the change in blue and green water resources is more sensitive to the changes in precipitation than to changes in the temperature.

For further reading: https://doi.org/10.3390/atmos12101280

RELATIONSHIP BETWEEN DROUGHT AND PRECIPITATION HETEROGENEITY: AN ANALYSIS ACROSS RAIN-FED AGRICULTURAL REGIONS IN EASTERN GANSU, CHINA

Suping Wang, Qiang Zhang, Jinsong Wang, Yuanpu Liu, and Yu Zhang

Based on daily meteorological data from 55 meteorological stations in eastern Gansu from 1960 to 2017, the characteristics of the drought process and precipitation heterogeneity were analyzed, and the relationship between drought and precipitation heterogeneity was evaluated. Results showed that there were 1–3 drought processes in the study area every year. Drought processes in the eastern and north-central regions were more frequent than those in other regions. Droughts were mainly manifested as intra-seasonal droughts, especially across the spring and summer. PCD (Precipitation Concentration Degree, the concentration degree of the precipitation at a certain time) ranged from 0.2 to 0.7 in the area. PCD increased in spring and autumn but decreased in summer and winter for most regions from 1960 to 2017. PCP (Precipitation Concentration Period, the shortest time which the precipitation was concentrated in) was from late April to early May in spring, mid-to-late July in summer, mid-September in autumn, and late January in winter. In the last 58 years, PCP has remained consistent in most regions, varying by approximately 10 days. In addition to insignificant changes in winter, the days with light and moderate rain presented a declining trend, especially in summer and autumn. The larger the PCD, the fewer the days with light and moderate rain, and the stronger the drought intensity. However, in the east-central region, the larger the PCD in autumn, the weaker was the drought intensity. This difference is related

to the PCP and the evapotranspiration. Additionally, the later the PCP, the stronger was the drought intensity, particularly in summer and autumn. When PCD was ≥0.5 in spring and ≥0.4 in summer, the PCP was after May and August in spring and summer, respectively. Droughts appeared in 28–56% of periods when seasonal precipitation was above normal. When PCD was ≥0.5 in autumn and PCP was in early and middle September, droughts appeared in 7% of periods when precipitation was above normal. Our results show that although less precipitation is the leading influencing factor of drought in the dry rain-fed agricultural areas, the influence of precipitation heterogeneity should be also considered for the prediction and diagnosis of seasonal drought.

For further reading: https://doi.org/10.3390/atmos12101274

RAPID EVALUATION OF THE EFFECTS OF POLICIES CORRESPONDING TO AIR QUALITY, CARBON EMISSIONS AND ENERGY CONSUMPTION: AN EXAMPLE FROM SHENZHEN, CHINA

Shi-Qi Yang, Jia Xing, Wen-Ying Chen, Fen Li, and Yun Zhu

Efficient environmental policies are necessary in the improvement of air quality and reduction in carbon emissions, and the interactions between policy, activity, emissions, and environment comprise a cycle allowing the evaluation of the effects of implemented policies. Based on the establishment of the connection between environmental parameters and policy context using a quantifiable methodology, in this study, we formulated a rapid and simplified pattern for the evaluation of the effects of policies concerning the atmospheric environment, and applied it to the evaluation and improvement of policies for Carbon dioxide (CO_2) reduction and air quality enhancement in the sample city of Shenzhen. The Response Surface Model-Visualization and Analysis Tool (RSM-VAT) in the Air Benefit and Cost and Attainment Assessment System (ABaCAS) was applied as the core tool. The required reductions in Fine particulate matter ($PM_{2.5}$) and Sulfur dioxide (SO_2) emissions for 2014–2019 are expected to be achieved; however, the expected reductions in Nitrogen oxides (NO_x) emissions (mainly from road mobile sources) and Volatile organic compounds (VOCs) emissions (mainly from secondary industry and road mobile sources) are less certain. According to the simulated concentration of $PM_{2.5}$ in 2019, it is necessary to reduce the concentrations of air pollutants, both within and outside Shenzhen. The background weather conditions may be the main reason for the increased concentrations of Ozone (O_3) in October compared to those in July. Reductions in NO_x and VOCs tend to be the main factors driving changes in O3 concentrations. Policies have been formulated and implemented in a wide array of areas. According to the quantitative comparative analysis of the policies, and the relevant activities, the greatest challenge in reducing NO_x and VOCs emissions is presented by the oil-powered vehicles in the road mobile sector and organic solvent production in the secondary industry sector. Therefore, in an effort to achieve better air quality and ensure that CO_2 emissions reach a peak in Shenzhen by 2025, we propose key improvements in policies based on interdisciplinary cooperation, involving not only atmospheric and environmental science, but also governance and urban planning.

For further reading: https://doi.org/10.3390/atmos12091221

CHARACTERISTICS OF MERCURY POLLUTION AND ECOLOGICAL RISK ASSESSMENT IN DIFFERENT DEGRADED GRASSLANDS OF THE SONGNEN PLAINS, NORTHEASTERN CHINA

Zhaojun Wang, Lei Wang, Gang Zhang, Xu Li, Xiangyun Li, Yangjie Zhang, Xuhang Zhou, Ming Chen, Tingting Xiao, Zhili Feng, Yue Weng, Zhanhui Tang, and Deli Wang

Mercury (Hg) is a global and widely distributed heavy metal pollutant. Mercury can affect human health as well as the health of ecosystems and poses ecological risks. The subjects of this study are three types of grassland in the Beidianzi region, Songnen Plains, Northeastern China, characterized by different degrees of degradation. The mercury content levels in the atmosphere, soil, and forage grass on the different grasslands were determined. In addition, the relationships between the mercury pollution levels in the atmosphere and soil, and the mercury distribution correlations between the soil and plants, were examined in detail. The potential risk index (RI), single factor index (PI), and ground accumulation index (Igeo) were used to evaluate the ecological risks. The results showed that the mercury content in the soils of three types of grassland exceeded the China national standard (GB36600-2018), and the soil mercury content in the moderately de- graded grassland was the highest. The single factor index method and land accumulation index method showed that the three types of grassland were slightly polluted, while the potential risk index showed that the three types of grassland were severely polluted, and the potential risk index of the moderately degraded grassland was the highest. The potential risk index decreased with the increase of soil depth. The variation trend of atmospheric mercury content was lower in the morning and evening and higher in the afternoon. The potential risk index of atmospheric mercury indicated that all types of grassland were at severe risk. There was a significant positive correlation between atmospheric mercury and soil mercury. The mercury content in herbage increased with the increase of degradation. The BP neural network prediction model constructed had good accuracy and had certain reference value.

For further reading: https://doi.org/10.3390/su131910898

THE NEXUS BETWEEN ENVIRONMENTAL IMPACT AND AGRICULTURAL SECTOR LINKAGES: A CASE STUDY OF PAKISTAN

Muhammad Jawad Sajid and Muhammad Habib ur Rahman

Agriculture has a substantial environmental impact. However, little research has been conducted on the relationship between agriculture's environmental impacts and linkages, particularly for the key agriculture-based Pakistani economy. Additionally, the literature on environmental linkages rarely estimates multiple types of linkages in a single study. This study fills these critical research gaps. The study estimates the land, water, nitrogen, and CO_2 impacts and linkages of Pakistan's agriculture sector using an input–output model and the hypothetical extraction method. The results indicated that agriculture directly accounted for approximately 27%, 93%, 92%, and 1% of Pakistan's total sectoral land, water, nitrogen, and CO_2 impacts (LWNC), respectively. While the sector indirectly contributed almost 2%, 0.3%, 0.4%, and 0.4% of Pakistan's total LWNC. The bulk of direct LWNC impacts were caused by agricultural purchases from downstream sectoral importers. The majority of the indirect LWNC impacts were induced by agriculture's re-imports. The agricultural purchases from the downstream sector of "Food and Beverages" induced the greatest environmental impact. To ensure sustainable agriculture, particularly in Pakistan, the agriculture sector's direct and indirect environmental impacts should be reduced not only through better management practices and technology, but also by focusing on intermediate sectoral sources of direct and indirect environmental impacts.

For further reading: https://doi.org/10.3390/atmos12091200

EXAMINING THE ASYMMETRIC EFFECTS OF PAKISTAN'S FISCAL DECENTRALIZATION ON ECONOMIC GROWTH AND ENVIRONMENTAL QUALITY

Xiaolong Li, Muhammad Zeeshan Younas, Zubaria Andlib, Sana Ullah, Sidra Sohail, and Muhammad Hafeez

This study aims to investigate the asymmetric fiscal decentralization effect on economic growth and environmental quality by using Pakistan data from 1984 to 2018. Our findings demonstrate that expenditure decentralization has asymmetric effects on economic growth and CO_2 emissions in short- and long-run in Pakistan. Therefore, positive and negative fluctuations in expenditure decentralization affect economic growth and CO_2 emissions differently in Pakistan. The results of asymmetric ARDL suggested that negative shock of revenue decentralization is reduced the economic growth and CO_2 emissions in the short and long-run, while positive shock of revenue decentralization is reduced the economic growth and CO_2 emissions. Our asymmetric results are country specific and more effective in policy analysis in Pakistan. The outcomes of this study may also help Pakistan's local governments and the central government in addressing the problem of economic growth and environmental pollution.

FORECASTING OF DROUGHT: A CASE STUDY OF WATER-STRESSED REGION OF PAKISTAN

Prem Kumar, Syed Feroz Shah, Mohammad Aslam Uqaili, Laveet Kumar, and Raja Fawad Zafar

Demand for water resources has increased dramatically due to the global increase in consumption of water, which has resulted in water depletion. Additionally, global climate change has further resulted as an impediment to human survival. Moreover, Pakistan is among the countries that have already crossed the water scarcity line, experiencing drought in the water-stressed Thar desert. Drought mitigation actions can be effectively achieved by forecasting techniques. This research describes the application of a linear stochastic model, i.e., Autoregressive Integrated Moving Average (ARIMA), to predict the drought pattern. The Standardized Precipitation Evapotranspiration Index (SPEI) is calculated to develop ARIMA models to forecast drought in a hyper-arid environment. In this study, drought forecast is demonstrated by results achieved from ARIMA models for various time periods. Result shows that the values of p, d, and q (non-seasonal model parameter) and P, D, and Q (seasonal model parameter) for the same SPEI period in the proposed models are analogous where "p" is the order of autoregressive lags, q is the order of moving average lags and d is the order of integration. Additionally, these parameters show the strong likeness for Moving Average (M.A) and Autoregressive (A.R) parameter values. From the various developed models for the Thar region, it has been concluded that the model (0,1,0)(1,0,2) is the best ARIMA model at 24 SPEI and could be considered as a generalized model. In the (0,1,0) model, the A.R term is 0, the difference/order of integration is 1 and the moving average is 0, and in the model (1,0,2) whose A.R has the 1st lag, the difference/order of integration is 0 and the moving average has 2 lags. Larger values for R^2 greater than 0.9 and smaller values of Mean Error (ME), Mean Absolute Error (MAE), Mean Percentile Error (MPE), Mean Absolute Percentile Error (MAPE), and Mean Absolute Square Error (MASE) provide the acceptance of the generalized model. Consequently, this research suggests that drought forecasting can be effectively fulfilled by using ARIMA models, which can be assist policy planners of water resources to place safeguards keeping in view the future severity of the drought

WASTEWATER BASED ENVIRONMENTAL SURVEILLANCE OF TOXIGENIC *VIBRIO CHOLERAE* IN PAKISTAN

Tanzeel Zohra, Aamer Ikram, Muhammad Salman, Afreenish Amir, Asim Saeed, Zurva Ashraf, and Abdul Ahad

Pakistan has been experiencing intervals of sporadic cases and localized outbreaks in the last two decades. No proper study has been carried out in order to find out the environmental burden of toxigenic *V. cholerae* as well as how temporal and environmental factors associated in driving cholera across the country. We tested waste water samples from designated national environment surveillance sites in Pakistan with *RT-PCR* assay. Multistage sampling technique were utilized for samples collection and for effective sample processing Bag-Mediated Filtration system, were employed. Results were analysed by district and month wise to understand the geographic distribution and identify the seasonal pattern of *V. cholera* detection in Pakistan. Between May 2019, and February 2020, we obtained and screened 160 samples in 12 districts across Pakistan. Out of 16 sentinel environmental surveillance sites, 15 sites showed positive results against cholera toxigenic gene with mostly lower CT value (mean, 34±2) and have significant difference ($p < 0.05$). The highest number of positive samples were collected from Sindh in month of November, then in June it is circulating in different districts of Pakistan including four Provinces respectively. *V. cholera* detection do not follow a clear seasonal pattern. However, the poor sanitation problems or temperature and rainfall may potentially influence the frequency and duration of cholera across the country. Occurrence of toxigenic *V. cholerae* in the environment samples showed that cholera is endemic, which is an alarming for a potential future cholera outbreaks in the country.

Highlight of the Issue

Organocatalysis - a greener tools for molecular construction wins the chemistry Nobel Prize

Two scientists working on organocatalysis – a tool that can speed up chemical reactions to construct specific molecules won the Nobel Prize for 2021 in chemistry. Chemists Benjamin List of the Max-Planck-InstitutfürKohlenforschung in Mülheiman der Ruhr, Germany and David MacMillan of Princeton University, independent of each other, have developed a third type of catalysis in 2000 called *asymmetric organocatalysis*. This concept for catalysis is ingenious and is believed to have revolutionized chemical world particularly pharmaceuticals, with efficient and more environmentally friendly manner. In fact, this tool avoids using toxic metals in synthesizing chemicals.

https://www.sciencenews.org/article/chemistry-nobel-prize-2021-molecule-build-tool-list-macmillan

https://www.nobelprize.org/prizes/chemistry/2021/press-release/