Journal of Nepal Hydrogeological Association (JNHA)

Volume 2 August 2025 Special Issue

ABSTRACT VOLUME

1ST Nepal Hydrogeological Conference

August 20-21, 2025

Kathmandu, Nepal

Published by

Nepal Hydrogeological Association

Babarmahal, Kathmandu, Nepal

Estd. 2011 A.D. (2067 B.S.)

Email :info@nha.org.np

Website : www.nha.org.np

1ST NEPAL HYDROGEOLOGICAL CONFERENCE

HYDROGEOLOGY OF NEPAL HIMALAYA AND ADJACENT REGION

"Groundwater for people and Ecosystems: Sustainability and Resilience in the changing world"

August 20-21, 2025
Kathmandu, Nepal

Organized by

Nepal Hydrogeological Association
In Association with
Kathmandu Valley Water Supply Management Board (KVWSMB)
&
Geo Hydro Consult Pvt. Ltd.

Organizing Committee

Chair: Prof. Dinesh Pathak
Convener: Dr. Dibya Ratna Kansakar
Secretarait: Mr. Anil Khatri
Members

Mr. Khila Nath Dahal
Mr. Surendra Raj Shrestha
Prof. Vishnu Prasad Pandey
Dr. Kabi Raj Paudyal
Dr. Moti Lal Rijal
Mr. Dipendra Laudari
Dr. Ananta Man Singh Pradhan
Mr. Kameshwar Yadav
Mr. Dev Kumar Syangbo
Mr. Anil Khatri
Mr. Bala Ram Upadhyaya
Mr. Om Khadka
Mr. Pushpa Raj Dahal
Mr. Subash Acharya
Ms. Manjari Acharya
Mr. Govinda Ojha
Mr. Nabin Parajuli
Dr. Manita Timilsina
Dr. Kanchan Chaulagain
Mr. Umesh Chandra Bhusal
Dr. Rabin Malla
Dr. Champak Babu Silwal
Mr. Vaskar Khatiwada
Mr. Dilandra Raj Pathak
Mr. Ashish KC
Mr. Basant Bhandari

Advisory Committee

- Mr. Yadav Lal Baidya Honorary Member, Nepal Hydrogeological Association, Nepal
- Mr. Mohan Singh Khadka, Honorary Member, Nepal Hydrogeological Association, Nepal
- Mr. Pratap Singh Tater, Past President, Nepal Hydrogeological Association, Nepal
- Mr. Suresh Raj Upreti, Past President, Nepal Hydrogeological Association, Nepal
- Mr. Andy Prakash Bhatt, Past President, Nepal Hydrogeological Association, Nepal
- Mr. Narendra Khattri, Past President, Nepal Hydrogeological Association, Nepal
- Mr. Moti Bahadur Kunwar, Past President, Nepal Hydrogeological Association, Nepal
- Dr. Bhagwan Singh Chaudhary, Professor, Kurukshetra University, Kurukshetra, India
- Dr. Venkatesh Raghavan, Professor, Geoinformatics Lab, Osaka Metropolitan University, Japan
- Dr. S.K Srivastav Chief General Manager, Regional Centres (RCs), National Remote Sensing Center, Government of India
- Dr. S.P. Aggarwal Director, North Eastern Space Applications Centre, Government of India Dr. P. K. Joshi, Professor, School of Environmental Sciences (SES)/Special Centre for Disaster Research (SCDR), JNU, India
- Dr. Oscar Kithsiri Dissanayake, Professor, Department of Earth Resources Engineering, University of Maratuwa, Sri Lanka
- Mr. Churna Bahadur Wali, President, Nepal Geological Society
- Mr. Thakur Prasad Sharma, President, Society of Consulting Architectural & Engineering Firms (SCAEF Nepal)

- Dr. Ranjan Kumar Dahal, President, Nepal Society of Engineering Geology (NSEG)
- Dr. Indra Acharya, President, Nepal Geotechnical Society
- Mr. Nir Shakya, Senior Hydrogeologist
- Mr. Shanmukhesh Chandra Amatya, Senior Hydrogeologist
- Dr. Subodh Dhakal, Head, Department of Geology, Trichandra Campus, TU
- Dr. Dhundi Raj Pathak, President, CREEW

Partner Organization

- Central Department of Geology, Tribhuvan University
- Department of Geology, Tri-Chandra Campus, Tribhuvan University
- Department of Water Resources and Irrigation, Ministry of Energy, Water Resources and Irrigation, Government of Nepal
- Department of Mines and Geology, Government of Nepal
- Department of Water Supply and Sewerage Management, Government of Nepal, Kathmandu
- Water Resources Research and Development Centre, Pulchowk, Lalitpur
- Kathmandu Valley Water Supply Management Board (KVWSMB)
- Nepal Society of Engineering Geology (NSEG)
- Nepal Geological Society
- Nepal Geotechnical Society
- Society of Consulting Architectural & Engineering Firms (SCAEF Nepal)
- Smart Phone for Water (S4W) – Nepal
- Center of Research for Environment, Energy and Water (CREEW)

Supporting Organization:

- Nepal Ekrat Engineering Company Pvt. Ltd. (NEEK)
- Hulas Steel Industries Pvt. Ltd.
- Albelo Multi Trading Pvt. Ltd.

- Annie Construction and Consultancy Company Pvt. Ltd
- Smart Earth Works Engineering Consultancy Pvt. Ltd.
- Shrestha Water House Pvt. Ltd.
- Geotech Solutions International (GSI) Pvt. Ltd.
- Full Bright Consultancy Pvt. Ltd.
- Kanchan Nirman Sewa Pvt. Ltd.
- Reshma Deep Boring Udhyog Pvt. Ltd.
- A-Z Engineering Consultancy Pvt. Ltd.
- Sharma Engineering Pvt. Ltd.
- Nawalpur Drilling Pvt. Ltd.
- Mega Consultancy Pvt. Ltd.
- GM Trade Pvt. Ltd.
- Explorer Geophysical Consultants Pvt. Ltd.
- AP Drilling Pvt. Ltd.
- Ram Laxmi Motor House Pvt. Ltd.
- Quartz Group Pvt. Ltd.
- Manifold Consult Pvt. Ltd.
- Himalayan Earth Science Research Center and Solutions Pvt. Ltd.
- Geological and Geotechnical Consultants Pvt. Ltd.
- Underground Space Engineering Pvt. Ltd.
- Strategic Geo Explorer Consultancy Pvt. Ltd.

Table of Contents

Keynote Talk

Groundwater Quality, Contamination, and Health Risks

Groundwater Sustainability, Policy, and Management

Hydrogeological Hazards, Climate Change, and Environmental Stress

Tools, Methods, and Innovations in Hydrogeology

Groundwater Recharge, Springs, and Surface-Water Interactions

Case Studies and Regional Groundwater Assessments

Water-Rock Interaction in Aquifers: Tracing Sources and Dating Groundwater Ages Using Stable and Radioactive Isotopes

[1]Jaisi, D.P.*

[1]*Interdisciplinary Science and Engineering Laboratory, Department of Plant and Soil Sciences; Earth Sciences, University of Delaware, USA*

*Corresponding Author: jaisi@udel.edu

ABSTRACT

Water-rock interactions in aquifers play a crucial role in regulating the mobility, availability, and long-term cycling of nutrients and metals. Primary minerals like apatite, along with secondary phases such as iron and aluminum phosphates, are commonly present in aquifers. Shifts in redox conditions may facilitate the mobilization of sediment-bound phosphorus, potentially leading to its release into open water bodies, such as rivers and lakes. This presentation will explore the geochemical properties of aquifers—including pH, redox potential, ionic strength, and microbial activities—that affect the subsurface flux of phosphorus. It will utilize case studies of the Cape Cod aquifer in Massachusetts, where phosphate oxygen isotopes are employed to discern these processes and identify the mechanisms of phosphorus release, alongside hydrogen and oxygen isotopes of water for investigating groundwater recharge and dynamics. Furthermore, this talk will include the use of non-conventional radiogenic isotopes, specifically Kr-81 and Cl-36, for accurate dating of groundwaters as old as a few million years. This talk will culminate by highlighting the need to integrate these complementary techniques with hydrogeochemical modeling for a holistic understanding of storage, transport, and release of water and nutrients from groundwater reservoirs to open waters.

Keywords: *Water-Rock Interaction, Stable and Radioactive Isotopes, Dating, phosphorus*

Groundwater Management Challenges in Nepal: Institutional Perspectives and Future Directions

[1]Tater, P.S.*

[1]*Freelancer Hydrogeologist, Suncity Apartments, Kandaghadi, Kathmandu*

*Corresponding Author: taterpratap@gmail.com

ABSTRACT

Groundwater mining is a vital resource providing irrigation water, drinking water, industrial water and transport medium for other socio-economic activities for millions of people of the country. The development of groundwater in the country initiated with traditional dug wells, springs and hand pumps, followed by construction of shallow and deep tubewells supplemented by institutional support from government organizations. In successive years, various national institutions such as the Ground Water Resources Development Project (GWRDP) under Groundwater Resources Development Board (GWRDB) and Department of Irrigation) evaluated several groundwater investigation and aquifer characterization programmers in addition to few groundwater development irrigation schemes mainly confined to Terai and Ground Water Study in Dun Valleys such as Kathmandu and Surkhet. GWRDB and GWRDP is not exist now.

At present there are two major institutions such as DoWRI and DWSSM involved in the development of ground water for irrigation and drinking water. Similarly, the private sector such as Users committee, Industries and private household are also involved in using ground water.

But, at present, there is not a single entity in the country to study the ground water problems, risk and management arising in the country.

Therefore, groundwater management in Nepal is facing a major challenge as over-extraction (?), water level depletion (?), and deterioration in quantity and quality. It is all due to the result of weak or no institutional mechanisms, non-technical guidelines, random drilling & unregulated exploitation without regard to groundwater policies / regulations. We must take lesson from the neighbouring countries around Nepal.

Therefore, to address and mitigate the problems of groundwater arising in the country, it is important to have one federal level and provincial level groundwater organizations in the country.

Keywords: *Groundwater, Hydrogeology, Institutional Framework, Management, Nepal*

Engineering Geological Implications of Rainwater Harvesting in the Nepal Himalaya

[1]Dahal, R.K.*

[1]*Central Department of Geology, Tribhuvan University, Kirtipur, Kathmandu, Nepal*

*Corresponding Author: rkdahal@gmail.com

ABSTRACT

Rainwater harvesting (RWH) is a sustainable practice in the Nepal Himalaya, addressing water scarcity and mitigating geological hazards. This presentation explores the engineering geological considerations of RWH, emphasizing its dual role in resource management and hazard reduction. Nepal's unique physiography, characterized by high rainfall variability and dynamic geology, makes RWH particularly significant. Until now, techniques such as recharge pits, trenches, and check dams in streams are employed to enhance groundwater recharge and control surface runoff, thereby reducing flooding, landslides, and soil erosion.

The advantages of RWH include alleviating pressure on groundwater, supporting agricultural irrigation, and providing non-potable water for daily use. However, improper design or implementation can lead to engineering geological challenges, such as pond outflow due to porous soils, structural failures, or slope instability. Case studies highlight successful RWH applications, while failures in few areas, underscore the importance of proper construction and maintenance. Key engineering geological concerns include soil permeability, berm stability, sedimentation, and seismic risks.

The presentation concludes with best practices for RWH pond construction, emphasizing watershed size, sediment control, and dam design. Proper planning and adherence to guidelines are critical to ensuring RWH systems are geologically sustainable both in mountain and in household basis. By integrating RWH with local hydrogeological conditions, Nepal can harness its monsoon rains effectively, balancing water security with slope stability and disaster resilience.

Keywords: *Rainwater Harvesting, Nepal Himalaya, Groundwater Recharge, Landslides, Engineering Geology.*

Applications of Geoinformatics for Sustainable Land and Water Resources Management in Himalayan Ecosystem: A case study of K-J Watershed, Shiwalik Region, North India

[1]Chaudhary, B.S.*

[1]*Department of Geophysics, Kurukshetra University, Kurukshetra -136119, INDIA*

*Corresponding Author: bschaudhary@kuk.ac.in

ABSTRACT

Sustainable land and water resources management is of utmost importance specifically in mountain ecosystem as it is quite sensitive and has become more so in the wake of climate change perspective. In recent years, there is increased focus on mapping and management of natural resources on watershed basis as it is a natural hydrologic unit and gives an advantage of understanding natural resource management problems in holistic manner. Geoinformatics plays an important role in mapping and management of natural resources. It connotes synergistic use of Remote Sensing, GIS, GPS & ICT to provide effective tool to planners and decision makers. The effective planning for watershed conservation and management can be done depending on the size of the catchments ranging from 1:50,000 scale to 1:10,000 scales. Remote Sensing and GIS collectively play an essential role in watershed studies. The multi-temporal and multi to hyper spectral earth observation data through optical and radar satellites is continuously generating huge spatial data source for the scientific community which is easing to address the environmental and hydrogeological challenges created across the globe due to natural and anthropogenic influences

Koshalya & Jhajhara (K-J), two tributaries of Ghaggar River, Shiwalik region of north India, have been chosen for the purpose. To achieve the objectives morphometric analysis, Land Use/Land Cover (LU/LC) mapping, Soil erosion risk assessment and Ground Water Potential Zone (GPZ) mapping have been done using Geographic Information System (GIS). Aster DEM (30 m) has been used for morphometric analysis and to generate drainage density and slope map of the area. LU/LC mapping and monitoring has been done by using Landsat (7 ETM^+ and 8) data for the time window 1999–2000 to 2015–2016. A considerable change from 7.12 to 24.84 km^2 is detected under built-up land. The soil loss in watershed has been evaluated by collective use of Revised Universal Soil Loss Equation (RUSLE) and GIS. The result indicates that only 6.54% of watershed area comes under moderate-high to high soil erosion category. After integration of various thematic layers, GPZ map of the watershed has been prepared by applying Analytical Hierarch Process (AHP) approach. It is observed that only 4.91 and 5.83 km^2 area fall under good and very good category and dominant portion of K-J watershed falls under the poor and very poor category of ground water availability.

The study indicates dominant conversion from agricultural and forest land to urban land. The watershed is suffering with increasing problems of deforestation, erosion and other land-use

conversion issues. Surface water resource action plan map has been prepared which depicts fifteen sites for percolation tanks and fourteen sites for check dams which needs further detailed geo-technical investigation as per site specific requirements. This is of utmost importance for groundwater amelioration and surface water conservation and optimal utilization. The suggested measures will lead to better management of land and water resources for the watershed. Geoinformatics has demonstrated its effectiveness in spatio-temporal mapping and monitoring of natural resources on watershed basis.

Keywords: *K-J Watershed, Shiwalik Region, Sustainable Natural Resource Management, Geoinformatics, Groundwater Potential Zone, Check Dams and Percolations Tanks.*

Multi-Tracer Isotopic Approach to Quantifying Groundwater Discharge and Classifying Lake Hydrology in the Badain Jaran Desert, China

[1]Jiao, J.*

[1]*Department of Earth and Planetary Sciences, The University of Hong Kong*

*Corresponding Author: jjiao@hku.hk

ABSTRACT

This study investigates the hydrological processes sustaining lakes in the arid Badain Jaran Desert (BJD) through comprehensive chemical and isotopic analyses. The research integrates multiple tracer approaches including stable oxygen and hydrogen isotopes ($\delta^{18}O$, $\delta^{2}H$), ^{222}Rn, and radium isotopes (^{223}Ra, ^{224}Ra, ^{226}Ra, ^{228}Ra) to characterize groundwater-lake interactions. Using isotopic buildup models, 38 desert lakes were classified into three types: flow-through, terminal, and desiccating, revealing spatial patterns of hydrological balance across the desert. Two independent mass balance approaches—^{222}Rn and Ra quartet models—were applied to quantify groundwater discharge rates into representative lakes of each type. Results indicate average groundwater discharge of 7.4 mm/d across the lake area, with specific rates of 9-10 mm/d for flow-through lakes, 7-8 mm/d for terminal lakes, and 5-6 mm/d for desiccating lakes. The total groundwater discharge to all desert lakes was estimated at 1.64×10^5 m^3/d. Notably, the study demonstrates that desert lakes function as "pumping wells" in the regional aquifer system, with groundwater level contours showing a depression around lake clusters. These findings provide critical insights into the water balance mechanisms sustaining desert oases and have implications for understanding the vulnerability of these unique ecosystems to climate change and water resource development.

Groundwater Contamination and Associated Risk to Human Health: A Case Study of a Coal Mining Area in India

[1]Tiwari, A.K.*

[1]*School of Environmental Sciences, Jawaharlal Nehru University, New Delhi-110067, India*

*Corresponding authors: ashwani.enviro@gmail.com; ashwaniktiwari@jnu.ac.in

ABSTRACT

Groundwater contamination is a major global issue, mainly due to geogenic and anthropogenic activities. People of many countries primarily depend on groundwater resources for drinking and domestic uses. Hence, the Sustainable Development Goals (6, 2022) aim to enhance the percentage of the global population with access to potable water by 2030. Regular monitoring of dissolved major and trace elements in groundwater, identifying sources of contaminants, and assessing associated risks to human health are essential to understanding the groundwater chemistry controlling factors and providing safe water to people for daily utilisation. A total of 100 groundwater samples were collected from the different locations of the Umaria coalfield of Madhya Pradesh on a seasonal basis to analyse for pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, and major and trace elements. The pH of the groundwater samples was slightly acidic to slightly alkaline, and TDS varied from 74 - 1,325 mg/L in the post-monsoon season and 87 - 1,611 mg/L in the pre-monsoon season. The hydrogeochemical approaches and statistical analysis suggest that rock weathering, ion exchange phenomenon and human activities in the study area mainly control the groundwater chemistry. The study suggests that the male and female populations have lower risks, while the child population remain vulnerable in the study area. Some dissolved major and trace elements exceeded the BIS guidelines, indicating appropriate treatment is required before utilisation for drinking and domestic uses.

Keywords: *Major and trace elements, Seasonal variation, Source identification, risk to human health and GIS*

From Dumpsites to Engineered Landfills: Protecting Groundwater through Sustainable Solid Waste Management in Municipalities of Nepal

[1,2]Pathak, D. R.*

[1]*Center of Research for Environment, Energy and Water (CREEW), Baluwatar, Kathmandu, Nepal*
[2]*Engineering Study & Research Centre, Suryabinayak-2, Bhaktapur, Nepal*

*Corresponding Author: drpathak@esarcnepal.com

ABSTRACT

Solid waste management (SWM) remains one of the most pressing environmental and public health challenges in municipalities of Nepal. Rising population, urban expansion, and shifting consumption patterns have significantly increased waste generation, underscoring the urgent need for integrated systems for waste collection, treatment, recovery, and safe disposal. Nepal's 293 municipalities generate nearly 6,000 tons of solid waste daily, with the Kathmandu Valley alone contributing about 25%. Organic waste accounts for more than 60% of the total, yet over 50% of the generated waste remains uncollected. Even collected waste is frequently subjected to open dumping such as Sisdol and Bancharedada landfill site, which has led to widespread surface and groundwater contamination from untreated leachate. Unmanaged plastic waste further exacerbates environmental and health problems, while also contributing to urban flooding due to drainage blockages. This paper highlights the critical issue of surface and groundwater contamination resulting from unmanaged waste disposal and explores the role of engineered landfill systems in mitigating these risks within Nepal's urban settings. The proposed strategy emphasizes a phased transition—from open dumping to controlled dumps, engineered landfills, and ultimately sanitary landfills—representing progressive improvements in site selection, design, construction, and operation. This transformation is guided by evolving environmental standards, regulatory monitoring, and enforcement mechanisms designed to safeguard public health and ensure long-term sustainability. Engineered sanitary landfills incorporate essential containment and barriers systems such as clay or geomembrane liners based on geological barriers and hydrogeological conditions, leachate management systems, landfill gas (LFG) collection and venting, and post-closure water quality monitoring. Adopting the waste management hierarchy through holistic planning, institutional strengthening, stakeholder engagement, and sustainable financing can facilitate the systematic transformation of open dumps into sanitary landfills, which can significantly reduce public health risks, protect groundwater resources, and create a foundation for long-term urban sustainability in municipalities of Nepal.

Keywords: *Sanitary Landfill, Leachate Treatment, Geomembrane Liner, Groundwater Contamination, Geological Barrier*

Assessment of Groundwater Quality and Utilization in Morang District, Eastern Nepal

[1]Mishra, R.* and [2]Rijal, M.L.

[1,2] *Central Department of Geology, Kirtipur, Kathmandu*

*Corresponding Author: mishrabina22@gmailcom

ABSTRACT

Groundwater, stored in aquifers beneath the surface, is a major freshwater source worldwide. It emerges naturally as springs, where the geological and hydrological conditions permit, producing a concentrated discharge. This study examines spring type, water quality, and utilization pattern of Terai zone of Morang District, Eastern Nepal, based on chemical analysis of 16 sources. These comprise of 9 contact springs, occurring at the interface between conglomeratic and clay layers, and 7 depression springs formed in clay-rich depressions. Field visit was carried out to collect primary data of spring inventory and in-situ measurement and laboratory analysis was carried out for chemical test of water. In-situ measurements included electrical conductivity (EC), total dissolved solids (TDS), and salinity, while laboratory analyses determined major ions, iron (Fe), manganese (Mn), and ammonia (NH_3). In-situ measurements shows pH ranging from 6.5 to 7.5, electrical conductivity (EC) from 150 to 621 µS/cm, total dissolved solids (TDS) from 97 to 410 mg/L, and salinity from 0.07 to 0.32 ppt. Depression springs show low average value of in-situ parameters compared to contact springs. Chemical test shows bicarbonate-dominated chemistry in all samples, with depression springs showing Na–HCO_3 type water and contact springs displaying mixed type. Iron (Fe) ranges from 0.20 to 0.86 mg/L, manganese (Mn) from 0.20 to 1.00 mg/L in 50% of samples, and ammonia (NH_3) from 0.10 to 1.00 mg/L. Several exceed WHO guideline values for Fe and Mn. Water Quality Index (WQI) classifies excellent to unsuitable quality of water with depression springs generally of better quality. Utilization surveys shows 67% of these springs are used for drinking and domestic purposes, 19% for irrigation, and 14% for religious activities. The overall study reveals that the spring water in the study area exhibits generally good physio-chemical quality, with some variations, and utilization extends to domestic, household, and agricultural purpose, though full potential remains underutilized and highlights the need to protect and monitor these groundwater sources for sustainable water management in the area.

Keywords: *Contact Spring, Depression Spring, Water Quality, Utilization*

Assessment of Shallow Tube Wells using In-Situ Physio-Chemical Parameters Along Karnali-Geruwa River Corridor, Western Nepal.

[1]Neupane, S.*, [1]Rijal, M.L.

[1]*Central Department of Geology, Tribhuvan University, Kirtipur, Nepal*

*Corresponding Author: sachina.815707@iost.tu.edu.np

ABSTRACT

A dry-season hydro geochemical survey was conducted along the Lower Karnali River basin, from Chisapani to the Nepal–India border, to assess spatial variations in in-situ water quality parameters within the Karnali and Geruwa river corridors. A total of 72 samples including river water, shallow wells, deep wells, and canal water were analyzed for pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), and oxidation-reduction potential (ORP). Shallow wells exhibited a mean pH of 7.32, ranging from 5.74 to 8.20, indicating slightly alkaline conditions. EC and TDS showed mean values of 622.70 µS/cm and 407.63 mg/L, respectively, with shallow wells recording the highest values (up to 1,326 µS/cm and 887 mg/L), suggesting enhanced mineralization influenced by lithology and local anthropogenic inputs. DO in wells averaged 3.41 mg/L (range 1.1–7.8 mg/L), compared to 11.2–13.8 mg/L in river samples, reflecting lower oxygenation in groundwater. The observed variations in EC, TDS, and DO across all samples reflect the combined influence of natural hydrogeological processes and human activities on water quality. ORP in wells had a mean value of 26.02 mV, ranging from -194 to 139 mV, indicating the presence of both reducing and oxidizing microenvironments. Rapid measurement of in-situ parameter in selected shallow well samples showed active redox reactions, causing quick transformation of iron from soluble to insoluble forms. This indicates that certain wells exhibit highly reactive conditions, which may have potential implications for human health in communities directly consuming groundwater.

Keywords: *Lower Karnali River, hydro geochemistry, shallow wells, dissolved oxygen, redox potential*

Hydrogeochemical and Microbial Dynamics of Groundwater-Surface Water Interactions in Pokhara Valley, Nepal

[1]Malla, R.*, [1]Pathak, S. and [1]Pathak L.

[1]*Ceter of Research for Environment, Energy and Water (CREEW), Baluwatar, Kathmandu, Nepal*

*Corresponding Author: rabin@creew.org.np

ABSTRACT

Pokhara Valley, a rapidly urbanizing tourism hub in Nepal, depends on groundwater and surface water amid growing pressure from population, land-use changes, and pollution. This study investigates seasonal hydrogeochemical and microbial characteristics across 25 sites of various water sources, which includes groundwater from the deep tubewells and shallow tubewells, and surface water from lake (Phewa Lake) and rivers (Harpan, Firke, Fusre, Seti); to assess contamination risks and groundwater-surface water connectivity. Samples were collected in dry and wet seasons, analyzing physicochemical parameters (pH, EC, SS, DO, BOD_5, CODCr, T-N, T-P) and fecal contamination indicator (E. coli). Statistical tools, including ANOVA, Tukey HSD, and PCA, elucidated seasonal patterns and water source interactions.

Deep groundwater exhibited high mineralization (EC: 517–802 µS/cm) with neutral-alkaline pH (6.9–7.9) and low nutrients (T-N <1.1 mg/L), but microbial contamination (E. coli up to 292 CFU/100 ml) indicated surface water percolation. Shallow tubewells showed similar trends but higher vulnerability (E. coli up to 765 CFU/100 ml). Surface water displayed seasonal extremes: rivers had elevated SS (>1900 mg/L wet season) and E. coli (up to 880 CFU/100 ml), while lake waters were microbially laden (up to 1000 CFU/100 ml dry season). PCA revealed transitional mixing zones (e.g., sites G-4, SW-2, SW-3), confirming localized aquifer-surface connectivity, especially during wet seasons. Findings highlight urbanization-driven vulnerabilities, with groundwater at risk from surface pollution. Recommendations include protecting recharge zones, periodic monitoring and evaluation, and integrated management of water resources for urban water security in Himalayan valleys. This contributes to understanding hydrogeological dynamics in tectonically active regions like Nepal.

Keywords: *Hydrogeochemistry, Microbial Contamination, Groundwater-Surface Water Interaction, Pokhara, Phewa Lake.*

Responding to Water Insecurity in Madhesh Province: Insights and Ways Forward

[1,2]Pandey V. P.* and [3] Pudasaini, K.

[1]*Department of Civil Engineering, Pulchowk Campus, Institute of Engineering, Tribhuvan University, Nepal*
[2]*Center for Water Resources Studies, Institute of Engineering, Tribhuvan University, Nepal*
WaterAid Nepal, Lalitpur, Nepal

*Corresponding Author: vishnu.pandey@pcampus.edu.np

ABSTRACT

After the Government of Nepal declared a 3-month long disaster emergency in Madhesh Province, groundwater crisis in the province got national-wide attention. However, no clear ways forward on addressing water insecurity in the province have been agreed so far. In this context, this research aims to provide some insights from data and link it to the groundwater system of Terai to highlight drivers as well as potential ways forward for short, medium and long-term. Rainfall data shows increase in consecutive dry days, decrease in early monsoon (June-July) precipitation, but a good amount of rainfall in the first five days of August 2025. These results indicate growing risk of crop failure associated with high-intensity short-duration rainfall and prolonged dryness. Further, groundwater level data shows increasing number and spread (in size) of groundwater hotspots in pre-monsoon season, but fluctuation in groundwater levels from 1.20 m to 2.09 m for the period of 2000 to 2015; thus, indicate recharge system is working and hypothesis for permanent decline in groundwater storage cannot be established. Potential solution strategy may vary with type of aquifer (e.g., perched or shallow or deep). The solution range may vary from prioritizing maintenance through "mobile maintenance team in campaign model" (short-term) to recharge interventions (mid-term), to prioritizing inter-basin water transfer projects (long-term).

Keywords: *Groundwater, Indo-Gangetic Aquifer, Madhesh Province, Terai, Water Security*

Establishment of Groundwater Wing in Department of Hydrology and Meteorology for Groundwater Management of Nepal

[1]Uprety, S.R.*

[1]*Ex-President, 2015-2017, Nepal Hydrogeological Association*

*Corresponding Author: sureshuprety@hotmail.com

ABSTRACT

Nepal is quite rich in water resources with its average annual renewable volume of 225 billion cubic meter. If we take 10% of this amount as groundwater recharge, it becomes 22.5 billion cubic meter renewable groundwater. Outer terai and inner terai gets comparatively higher recharge than hilly and mountainous areas. Within hills and mountains, there are valleys consisting of unconsolidated deposits which receive higher groundwater recharge. Compared to recharge, there is far less groundwater use on country level, but there is problem of groundwater level declining due to heavy pumping in urban areas. Nowadays problem of groundwater level declining has been seen in outer terai areas also due to deforestation in Siwalik region by human encroachment. Investigation of groundwater resources of Kathmandu Valley was started by Department of Mines and Geology in 1959 and in terai by Department of Water Resources Survey in 1968. Afterwards Groundwater Resources Development Board took over and carried out both investigations, studies and utilization for irrigation till 2024. Now this organization does not exist and according to Water Resources Policy 2077 of Nepal Government, groundwater management responsibility is with Water and Energy Commission. As user most of the individuals, irrigation and water supply institutions of Nepal Government, industries, apartments and residential colonies are using groundwater. But for monitoring purpose, there exists no national level institution at the moment. Department of Hydrology and Meteorology has only hydrology and meteorology wings. Department of Water Resources and Irrigation has groundwater wing but concentrates mostly on groundwater irrigation. Water Resources Research and Development Centre does not carry out groundwater monitoring activities. In this context, it will be appropriate to give responsibility of groundwater monitoring activities to Department of Hydrology and Meteorology by establishing groundwater wing and overall water resources management responsibility to Water Resources Research and Development Centre by changing its name to Department of Water Resources Management. Required manpower can be easily managed by transferring groundwater personnel from Department of Water Resources and Irrigation. The administrative control of Department of Water Resources Management and Department of Hydrology and Meteorology should be given to Water and Energy Commission.

Keywords: *Groundwater, Water and Energy Commission, Department of Hydrology and Meteorology, Department of Water Resources Management*

Groundwater Resources of Nepal: Are They Drying or Dying?

[1]Rijal, M. L.*

Central Department of Geology, Tribhuvan University, Kirtipur, Nepal

*Corresponding Author: moti.rijal@gmail.com

ABSTRACT

Nepal hosts huge amount of surface water resources with rivers originating from snow-fed region of Higher Himalaya to rain-fed southern rivers originating from Sub-Himalaya, also known as the Siwalik. As the country's more than 80% rainfall occurs in summer monsoon period of about 100 days, the rest of period remains dry. Therefore, Nepal is located in the region of too much and too little surface water availability. With increasing duration of drought and erratic precipitation patterns, dependency of people and ecosystems on groundwater resources are increasing rapidly during recent years.

Groundwater resources in Nepal, which occurs in millions of springs, mostly in the Middle hill and in the form of shallow and deep aquifers in Inner Terai and Terai regions of Nepal are known from the beginning of human settlements. Spring ('mul') in hills and 'chapakal' in Terai and Inner Terai are synonymous with human settlements for fulfilling drinking water demands. However, many traditional springs sources in Middle hill region are drying threatening water security of this region. In the Terai as well as in the Inner Terai region, which is a hotspot of increasing settlements areas of internally migrated people from the upper Middle hill, drying of shallow tube wells were also observed in several places of Madhesh Province of Nepal. As human impact on landscapes of Middle hill and Terai is increasing rapidly, natural water flows and recharge areas are modified significantly, which clarifies that Nepal's groundwater resources are not only drying but also dying in several places. Therefore, this paper highlights the current status of such cases of drying and dying of groundwater resources of Nepal emphasizing urgent needs for establishing a groundwater governance system at the federal level with a separate groundwater resources management and development frameworks for each province of Nepal.

Keywords: *Groundwater Resources, Water Security, Provincial Framework, Groundwater Governance, Nepal*

Technology and Equipment Selection for Real-Time Monitoring to Assess the Impact of Groundwater Level Change on the Ecosystem in Bangladesh Aquifers

[1]Azad, A.K. and [2]Warriar, R.*

[1]CEO Source and Service ,71, Motijheel Mahabub Mansion 4th Floor Dhaka- 1000|Bangladesh
[2]General Manager (South Asia) SEBA Hydrometerie GmbH, Kaufbeuren, Germany (Stationed at India Regional Office, B401, Delta Tower,1 Ulwe, New Mumbai 410 206)

*Corresponding Author: warriar@seba.de

ABSTRACT

Effective groundwater management hinges on accurate monitoring of water levels and related hydrological data. However, the inherent complexity of subsurface systems presents significant challenges in establishing reliable monitoring frameworks. Precision in water level measurements is critical for hydrogeological assessments, as it directly influences the ability to characterize aquifer dynamics and inform resource planning.

This study investigates a range of groundwater monitoring technologies and system configurations, with a focus on selecting solutions suited to the geographical, climatic, and socio-environmental context of Bangladesh. It situates groundwater monitoring within the broader scope of water resource governance, emphasizing strategic approaches to system design and implementation.

A purpose-driven methodology was adopted, encompassing system architecture, data acquisition, and analytical interpretation. Equipment installations were conducted in accordance with regional standards and under the jurisdiction of the Bangladesh Agricultural Development Corporation (BADC), Barind Multipurpose Development Authority (BMDA), and Bangladesh Water Development Board (BWDB).

Findings reveal that increasing stress on groundwater—due to climate variability, rapid urbanization, and inadequate management—necessitates the deployment of optimized and context-specific monitoring systems. Instruments from SEBA HYDROMETRIE GMbH & Co. Kg (Germany) demonstrated exceptional performance, achieving a measurement precision of 0.05% of full scale when applied to aquifers in Bangladesh. These results underscore the importance of selecting robust, high-resolution tools to enable real-time decision-making and sustainable resource management.

Keywords: *Water Level Monitoring, Automated Monitoring and Communicating System, Vented Sensors, SEBA HYDROMETRIE, and Ecosystem.*

Balancing the Water Supply in the Changing Climate: Pathways to Climate Resilient Water Governance in Syangja District, Nepal

[1]Kafle, D.* and [1]Dahal, N.

[1]*Nepal Water Conservation Foundation*

*Corresponding Author: kafledivya4@gmail.com

ABSTRACT

Focusing on the efforts of Galyang and Waling Municipalities of the Syanga district, a study of climate change impacts on water sector vulnerability was conducted since July 2024. The preliminary findings reveal that the region is already weakened by the active seismic activities and geologically unsettled hill slopes, the extreme weather events in the changing climate have detrimental impacts on the settlements and development infrastructures. The skewed rainfall pattern of over 80% of annual rainfall that occurs in summer often generate cycles of floods followed by prolonged droughts in the rest eight months.

A large chunk of annual budget of these municipalities is spent on building or maintenance of water supply schemes and irrigation facilities, while a significant portion goes to maintenance of roads affected by the extreme rainfalls during monsoon. While the municipal governments spend over 80% of their development budget on balancing the situation of the 'too much water and too little water (prolonged drought)', they hardly mobilize any hydrogeological expertise in the budgeted-project cycles. This imbalance imposes pressure on water sources, especially natural springs, which are extremely important to people in hilly regions like Waling and Galyang. Climate-induced extreme weather events, such as the July 2024 weather events that poured 625 mm of rain in a week, have harmed infrastructure, displaced families, and increased water scarcity.

The urban expansion and poorly planned infrastructure (e.g., roads disrupting natural drainage) further degrade water systems. Municipalities struggle with inadequate technical capacity, fragmented policies, and limited climate data integration, leaving marginalized groups- women, farmers, and low-income households- most vulnerable. Traditional spring-dependent communities now face dwindling flows, with some springs serving 80% fewer households than five years ago.

This study underscores the urgent need for climate-adaptive water governance, blending nature-based solutions with institutional reforms. By prioritizing local knowledge, equitable access, and resilient infrastructure, Syangja can model sustainable water management for Nepal's Himalayan regions.

Key Words: *Climate Pressure, Shrinking Water Sources, Governance Gaps, Equity*

A Proposal for Regional Water Budget Studies and Groundwater Diplomacy in the Nepal–India Region

[1]Neupane, K.R.*, [1]Dahal, P.R. and [2]Pokhrel, M.

[1]*Water Science and Management Program, New Mexico State University*
[2]*Department of Civil Engineering, New Mexico State University*

*Corresponding Author: neupanekaustuv@gmail.com

ABSTRACT

Nepal shares surface water resources with its southern neighbour, India, a fact well acknowledged. However, the transboundary nature of groundwater remains poorly documented. Recent research in India states indicates that the majority of flow in the Ganges River is contributed by ground water—primarily groundwater—rather than glacial melt and tributaries flowing into Ganges River. The location of recharge for this baseflow remains uncertain and could originate from nearby areas or further upstream, including glacier-fed systems or agricultural fields with ponded water. This uncertainty is further complicated by changing precipitation patterns and land use in the region. To understand the dynamics between surface and groundwater, a hydrologically based water budget is essential. Such an approach can support resource managers in making informed decisions to better serve water users, ecosystems, and communities. We propose a regional-scale water budget study that integrates both surface and groundwater components. Based on a review of global and Nepal–India case studies, we examine surface groundwater dynamics and present transboundary collaboration models, including the U.S.–Mexico groundwater cooperation framework, as potential pathways for developing integrated water budget strategies, including coordinated data acquisition initiatives and groundwater management plans. Our findings highlight the importance of transboundary groundwater diplomacy at multiple levels—among scientists, policymakers, and governments—to foster collaborative water governance in the region.

Keywords: *Transboundary, Recharge, Water budget, Surface and groundwater interrelation*

Chure-Bhabar Degradation and Groundwater of Terai: Insights from Aquifers in Koshi Province

[1]Acharya, B.,[1]Ghimire, B.,[1]Baral, B.,[1]Baniya, A.,[1]Shakya, A.,[1]Joshi, B.,[1,2]Pandey, V.P.*

[1]*Department of Civil Engineering, Pulchowk Campus, Institute of Engineering, Tribhuvan University, Lalitpur, Nepal*
[2]*Center for Applied Research and Development, Institute of Engineering, Tribhuvan University, Lalitpur, Nepal*

* Corresponding Author: vishnu.pandey@pcampus.edu.np

ABSTRACT

Though concerns on Chure-Bhabar degradation and its impact on groundwater of the Terai are increasing, comprehensive research is lacking to demarcate the Bhabar region, quantify degree of degradation, and establish a relation between degradation and groundwater storage. This study aims to address the knowledge gap. The Bhabar region was delineated using topographical maps; with northern boundary at a location where the streams are observed to lose water and look dry and southern boundary was set where streams reemerged at the surface. Degradation was characterized using five parameters: drainage density, land use/cover, soil texture, standardized precipitation index (SPI), and topographic wetness index (TWI). The degradation status of both Chure and Bhabar regions from 2000 to 2022 revealed significant parallel trends. Initially, both regions exhibited moderate degradation. However, from 2006 to 2016, degradation levels increased sharply, peaking in 2016, before showing signs of recovery by 2022. The Spearman's rank correlation with and without lagging were evaluated to assess direct and delayed effects. Results showed that degradation in the pre-monsoon season has more impact on groundwater. Although the degradation trends in both regions were parallel, the impact of Bhabar degradation on groundwater was more pronounced. These findings emphasize the need for targeted management strategies in the Bhabar region to mitigate the impacts of degradation on groundwater storage.

Keywords: *Chure-Bhabar, Degradation, Groundwater, Terai*

Ground Water Influence on Support System in Soft Ground Tunneling: A Case Study of Super Madi Hydroelectric Project, Kaski District, Nepal

[1]Panthee, S.* and [1]Ghimire, P.

[1]*Central Department of Geology, TU*

*Corresponding Author: panthisuman@gmail.com

ABSTRACT

Many problems encounters on soft ground tunnelling. In soft ground tunnel, soil mass of tunnel periphery deforms and collapses due to change in stress and soil mechanical properties as change in groundwater condition after excavation. The changes in water content, modify the soil properties that consequently deviates the stress field in tunnel periphery. The changes in stress field around the periphery directly effect on supports in the tunnel. A coefficient R_u plays important role in strength of soil materials and as water content changes in same depth the stability of the tunnel surrounding changes. Similarly, support required for a tunnel is a complex function of the properties and condition of the material, the geometry and orientation of the tunnel, and the construction procedures.

A case study from a soft ground tunnel is selected to understand how the stress field is modify in soil as the groundwater flow is changes and its effect on applies support system. In the study section consists clayey silt with gravel which belongs to GC in USCS. Increase in water saturation coefficient results the increase in displacement. Increase in ground water decreases the stability of tunnel. The support installed for R_u 0.4 condition with FOS 1.4 was not sufficient for R_u 0.6 condition. That is due to the increase in load at support with increase in water saturation. Similarly, the maximum vertical displacement occurs at crown and the displacement decreases as moved upward from crown. The displacement rate decreases rapidly as moved upward from crown which was shown from the generated power equation. The support capacity curve shown that the as groundwater condition increases the support capacity of applied support system moves towards critical zone. The parameter study was performed which shows that reducing the cohesion and friction angle result increment in displacement. Young's modulus was found as most sensitive parameter showing rapid increasing in displacement with reducing E.

Key Words: *Groundwater, Ru, Tunnel Deformation, Tunnel Supports*

Drying Wells of Madhesh: Causes, Evidence, and Solutions

[1]Mishra, A.K.* and [1]Shrestha S.R.

[1]*Retired Sr. Div. Hydrogeologist, Government of Nepal*

*Corresponding Author: aravindmishra66@gmail.com

ABSTRACT

Madhesh Province is experiencing an escalating groundwater crisis. Although the province has sufficient groundwater resources, recently it is experiencing decreased in water levels and drying wells particularly during the pre-monsoon period. This paper tries to identify the causes of the problem by comparing the groundwater stress situation from two contrasting locations Birgunj (Urban City) and Mewa (Rural Area) and proposes ways to address the situation. Haphazard extraction of groundwater and effect of climate changes has created this problem, rather than permanent decrease in groundwater storage. Irregular and high-intensity rainfall, reduced infiltration caused by deforestation and land use changes, together with higher water requirement due to population growth and intensified agriculture have created huge stress on groundwater resources. In Birgunj, heavy extraction from a low-storativity confined aquifer results in quick pressure drops and extensive well interference, causing seasonal pumping failures. In Mewa, dependence on a highly-storative phreatic aquifer allows for continuous yields thanks to quick local recharge, with faults primarily being mechanical. These results highlight that the issue is related to groundwater management rather than scarcity, emphasizing the need for strategies that combine environmental conditions with aquifer-specific hydrogeological insights.

Keywords: *Groundwater Crisis, Drying Wells, Unsustainable Management Practices, Terai Aquifer System, Aquifer Recharge*

Hydrogeological Influence of Groundwater Level Fluctuations on Debris Slope Stability in the Lesser Himalayan Terrain

[1]Shrestha, K.K.*, [2]Thapa, P.B., [1]Paudyal, K.

[1]*Central Department of Geology, Tribhuvan University, Kirtipur, Kathmandu, Nepal*
[2]*Tri-Chandra Multiple Campus, Tribhuvan University, Ghantaghar, Kathmandu, Nepal*

*Corresponding mail: kkshresthageology@gmail.com

ABSTRACT

Debris material slopes in the Lesser Himalayan Terrain are highly susceptible to instability during the monsoonal groundwater level (GWL) rise. The research evaluates GWL effects on slope stability through detailed field investigations, material characterization and advanced numerical modelling approaches. The research analyzed two debris slopes (Kokhe Slide, Gorkha at 28°01'36"N, 84°40'13"E & Udipur slide, Lamjung at 28°10'51"N, 84°25'43"E) that experienced repeated slope failures through the application of Limit Equilibrium Method (LEM), Finite Element Method (FEM) and Particle Finite Element Method (PFEM). The LEM and FEM analysis of pre-failure slope conditions showed that slopes remain stable when the GWL remains at least 7 meters below the ground surface (FoS > 1.3). However, the stability of the slopes declines gradually as the water table rises and ultimately failure conditions develop when the GWL is within 1 to 2 m from the ground surface. The saturation state of debris material resulted in a 40–66% reduction of shear strength and safety factors when compared to dry conditions. The FEM results have indicated significant increase in shear strain and displacement under elevated GWL. The post-failure simulations conducted by PFEM further quantified debris run out behaviour by showing velocities up to 23 m/s and run out distances of 400 m. The research shows that rainfall-induced groundwater rise stands as the main factor behind debris slope failures in the Lesser Himalaya thus requiring hydrogeological monitoring and drainage measures in slope management and infrastructure planning.

Keywords: *Debris-Slopes, Numerical Modelling, Slope Stability, FoS, Lesser Himalaya*

Hydrogeological Study of Karst Landscapes and Evaluation of Sinkholes and Subsidence Risk in Armala Area, Pokhara Valley

[1]Paudel, S.* and [1]Pathak, D.

[1]*Central Department of Geology, Tribhuvan University, Kirtipur, Kathmandu, Nepal*

*Corresponding Author: subekshyapaudel475@gmail.com

ABSTRACT

This research offers an in-depth study of the hydrogeology and geomorphology of the Armala karst region in the Pokhara Valley of Nepal. It examines the landscape's river terraces, the processes behind sinkhole formation, the vulnerability of groundwater through a GIS based DRASTIC modelling approach, as well as an evaluation of water quality. The area features two primary terrace levels: an upper terrace between 930 and 980 meters and a lower terrace between 900 and 930 meters, each displaying unique sediment layers that impact groundwater flow and the occurrence of sinkholes. The formation of sinkholes is mainly driven by a subsurface erosion process known as piping, which is intensified by natural factors like hydrological conditions and human activities including excavation and irrigation. The vulnerability map created through the DRASTIC model highlights zones of moderate to high risk, which closely align with areas prone to sinkholes. Chemical analysis of water samples reveals a dominant sodium–potassium–chloride–sulphate composition, with some localized increases in phosphate and ammonia levels, likely linked to agricultural runoff. To address these challenges, the study recommends implementing better land use regulation, enhancing drainage infrastructure, controlling chemical pollutants, and increasing local community awareness to effectively manage and reduce associated risks.

Keywords: *Pokhara Valley, Sinkhole Formation, Piping Mechanism, Groundwater Vulnerability, DRASTIC Model*

Status of Land Subsidence in Biratnagar Metropolitan City, Nepal

[1]Tiwari, I.*, [1]Tripathi, A., [1]Bhandari, B., [1]Malla, S., and [1]Silwal, C.B.

Department of Geology, Tri-Chandra Multiple Campus, Tribhuvan University, Kathmandu, Nepal

*Corresponding Author: ishatiwari124@gmail.com

ABSTRACT

Land subsidence is a major issue affecting urban cities globally. It is primarily driven by extensive groundwater overdraft and other anthropogenic activities, leading to subsidence of the ground surface. Biratnagar, a major city in eastern Nepal located on the Indo-Gangetic Plain, is experiencing rapid urbanization, groundwater over-extraction, and changes in land use, all of which contribute to the risk of land subsidence. The research aims to analyze surface deformation using the Interferometric Synthetic Aperture Radar (InSAR) technique. This could be the preliminary and very critical research on Land subsidence in Biratnagar, aiming to assess its status and inform the policy makers about the status to prepare for future necessary attention.

Keywords: *Land Subsidence, Sentinel-1, Indo-Gangetic Plain, InSAR, Biratnagar*

Disentangling Pseudo-karst Risk at an Artesian Spring Crossing on a Texas State Highway: An Integrated Geophysical and Geotechnical Approach

[1]Bhattarai, R.R.*

[1]*Terracon Consultants Inc., Dallas, TX, USA*

*Corresponding Author: roshanrajbhattarai@gmail.com

ABSTRACT

Along a 1,400-ft segment of a Texas state highway where an artesian spring intersects the highway embankment, we investigated whether groundwater discharge has driven subsurface voiding beneath the pavement or whether the observed hazards are dominated by surface-runoff erosion. Geophysical work combined multi-channel Ground Penetrating Radar (GPR), Frequency Domain Electromagnetic Induction (FDEMI), and Electrical Resistivity Tomography (ER) followed by geotechnical borings.

The ERT shows a resistive, differentially cemented sand/sandstone unit over a conductive clayey–silty unit, separated by a transitional contact that coincides with the water table; the resistive sand pinches out toward the spring line to the south, where springs emerge at the interface. GPR depth slices and radargrams resolved utilities and disturbed wet-clay zones but did not reveal significant depressions or voids; FDEMI maps show conductivity increasing with depth and peaking near the spring boundary - patterns consistent with saturated fine sediments rather than large cavities. Borings corroborate the geophysics, with groundwater stabilizing above a clay unit and no evidence of subsurface voids beneath the roadway. Taken together, the data indicates a low likelihood of pseudo-karst voiding under the pavement; the principal hazard is rapid, rainfall-driven surface discharge that is enlarging gullies, sinkhole-like collapses, and a tunnel at the spring outlet along the hinge line. We outline immediate implications for mitigation: early and robust drainage control during construction, sequencing during drier periods, and targeted monitoring.

Keywords: *GPR, FDEMI, Electrical Tomography (ET), Pseudo-karst Voiding*

Groundwater Storage Variation in the Indo-Gangetic Aquifer from Downscaled GRACE/GRACE-FO Data

[1]Ganesh, A., [1,2]Pandey V. P.* and [3]Talchabhadel R.

[1] *Department of Civil Engineering, Pulchowk Campus, Institute of Engineering, Tribhuvan University, Nepal*
[2] *Center for Water Resources Studies, Institute of Engineering, Tribhuvan University, Nepal*
[3] *Department of Civil and Environmental Engineering, Jackson State University, Jackson, MS, USA*

*Corresponding Author: vishnu.pandey@pcampus.edu.np

ABSTRACT

Changes in groundwater storage in the transboundary Indo-Gangetic aquifer poses a challenge to security of water, energy and associated resources. This study assesses groundwater storage anomaly (GWSA) variations from 2003 to 2020 using GRACE/GRACE-FO products, which are downscaled to a 0.1° resolution using Random Forest (RF) from 0.25°. Validation with observed groundwater level data shows GRACE-derived GWSA achieves correlation coefficients up to 0.7 with in-situ groundwater level anomalies (GWLA). Results reveal a statistically significant ($p<0.05$) terrestrial water storage depletion rate of 1.38 cm/year across the aquifer and 1.10 cm/year in Nepal's Terai region. Spatial analysis identifies a GWSA anomalies hotspot in the western region of the aquifer. A relatively higher hotspot was also observed in the eastern region of Terai. Enhanced transboundary management is critical, changes in groundwater storage and drought events cross administrative boundaries. Densifying monitoring wells with adequate spatial distribution, integrate high-resolution anthropogenic data, and implement sustainable strategies to mitigate climate and human-induced pressures on the aquifer, could be considered as potential ways forward.

Keywords: *GRACE, Groundwater Depletion, Indo-Gangetic Aquifer, Random Forest, Terai Region*

Spatio-Temporal Variation of Stable Isotope and Chemical Concentration in River Water of the Kathmandu Valley

[1]Bajracharya, R.*, [2]Nakamura, T., [1]Tamrakar, N.K. and [1]Ghimire, S.

[1]*Central Department of Geology (CDG), Tribhuvan University, Nepal*
[2]*Interdisciplinary Centre for River Basin Environment (ICRE), University of Yamanashi, Japan*

*Corresponding Author: bajrarami@yahoo.com

ABSTRACT

Understanding the hydro-chemical and isotopic composition of river water is crucial for assessing hydrological processes, water source contributions, and human impacts in rapidly urbanizing basins. Stable isotopes of hydrogen (δD) and oxygen ($\delta^{18}O$) are widely recognized as reliable natural tracers in hydrological research. The Kathmandu Valley, a tectonic intermontane basin in central Nepal, features a dense river network including major rivers such as the Bagmati, Bishnumati, Manahara, Dhobi, Hanumate, Godawari, Kodku, Nakhu, and Balkhu. Despite the significance of river systems in supporting local water resources, isotopic investigations of these rivers remain limited.

For the current study, 80 water samples were collected from nine rivers during the wet (August 2017) and dry (February 2018) seasons. Chemical ions were analysed using ion chromatography, and stable isotopes (δD and $\delta^{18}O$) were measured with cavity ring-down spectroscopy. A narrow spatial variation of isotopes was observed along individual river corridors, with the Godawari Khola showing the widest isotopic variation (δD: 5 to 12.5‰; $\delta^{18}O$: 0.9 to 2.6‰). Isotopic values exhibited significant seasonal differences, ranging from -63.5‰ to -46.0‰ for δD and -9.1‰ to -6.2‰ for $\delta^{18}O$ across seasons. The δD versus $\delta^{18}o$ plots indicate that all river water from the wet season lies on or close to the LMWL, suggesting precipitation as the main source of river discharge. However, in the dry season, most of the river water becomes heavier, except for the Kodku Khola.

Chemical analysis showed a seasonal shift from Ca^{2+} dominance in the wet season to Na^{+} in the dry season, with notable temporal variations in most ions ($p < 0.01$). A strong correlation among ions indicated human influence, especially with increased NH_4^{+}-N and PO_4^{3-}-P levels during the dry season, except in Godawari Khola. Hydrochemical facies analysis revealed that river water mainly belonged to the Ca-HCO_3^{-} type during the wet season, shifting to Na-K-HCO_3^{-} in the dry season for northern rivers. Conversely, southern rivers largely maintained their original water type.

Keywords: *Spatio-Temporal Variation, Stable Isotopes, Chemical Ions, River Water, Kathmandu Valley*

Layer by Layer: Transforming Nepal's Groundwater Data for Next-Generation Modelling and Policy

[1,2]Shakya, B.M*, [2,3]Thapa, B.R., [4]Pathak, [5]Shrestha, A.M.*, [5]Shrestha, B.N.

[1]*Center of Research for Environment, Energy, and Water (CREEW), Baluwatar, Kathmandu, Nepal*
[2]*Development Support Consult Pvt. Ltd. (DSC), Sankhamul, Lalitpur, Nepal*
[3]*Universal Engineering and Science College, Chakupat, Lalitpur, Nepal*
[4]*Central Department of Geology, Tribhuvan University, Kirtipur, Nepal*
[5]*UNICEF Nepal, Pulchwok, Lalitpur, Nepal*

*Corresponding: inform.bj76@gmail.com, amaskeyshrestha@unicef.org

ABSTRACT

As Nepal's groundwater sector leaps towards groundwater management and sustainability, modelling for creating a bigger picture has been the topic of interest for the majority. However, the accuracy and resolution of deep groundwater monitoring data have become critical bottlenecks in the advancement. The prevailing approach of multiple-screened single tubewells, which is cheaper, provides a general understanding of the water level; however, blurs vertical groundwater movements and distinctions, complicating model calibration, hydrostratigraphic interpretation, and policy-relevant analysis. The entitled presentation aims to advocate for a paradigm shift to strategically placed, single-screened multi-tubewell clusters that capture depth-specific groundwater dynamics with accuracy. Such an approach enables precise parameterisation of layered aquifer systems, supports early detection of contamination pathways, and directly strengthens model-driven decision-making. Drawing on field experiences and stakeholder consultations, the ongoing work highlights its transformative potential for bridging science, policy, and management practice. Implementing this shift is not merely a technical upgrade but is foundational to evidence-based groundwater governance in Nepal.

Tracing Seepage Pathways in Concrete-Faced Rockfill Dams Using Stable Isotopes

[1,2]Shakya, B.M., [3]Singh, J.L.* and [4]Chhatkuli, N.*

[1]*Center of Research for Environment, Energy, and Water (CREEW), Baluwatar, Nepal*
[2]*Development Support Consult Pvt. Ltd. (DSC)*
[3]*Mechanized Irrigation Innovation Project, Department of Irrigation (DoI), Ministry of Energy, Water Resources, and Irrigation (MoWRI)*
[4]*Praganna and Badkapath Irrigation Management Office, Department of Irrigation (DoI), Ministry of Energy, Water Resources, and Irrigation (MoWRI)*

*Corresponding Author: jaya.sin16@gmail.com

ABSTRACT

Understanding seepage processes in concrete-faced rockfill dams (CFRDs) is critical for ensuring long-term safety and sustainability. At the Dhap Dam in Kathmandu, water accumulation was observed at the toe of the main dam and saddle dams 1 and 2, raising concerns about seepage of sources. This study applied stable isotopes of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) to determine whether the seepage originated from the reservoir or the surrounding groundwater. Twenty-eight samples were collected from the reservoir (multiple depths), seepage points, inlet springs, and rainfall between 3–16 June 2024, and compared with isotopic records from 2016 and 2022. Reservoir water plotted along an evaporation line, enriched in $\delta^{18}O$ and $\delta^{2}H$, while springs aligned closely with the Global Meteoric Water Line (GMWL). Seepage samples fell between these endmembers, suggesting a mixing origin. A two-endmember mixing analysis indicated that seepage water is composed of approximately 30-40% reservoir water and 60–70% groundwater. The main dam seepage aligned more closely with the reservoir signal, whereas saddle dam seepage reflected greater influence from local groundwater inflows. Overall, the study demonstrates that isotopic techniques, supported by mixing analysis, are effective in distinguishing seepage pathways in CFRDs and provide essential insights for maintaining dam integrity, dam safety monitoring, and sustainable water management.

Groundwater Monitoring Well Network Design using ArcGIS and Multi-Criteria Analysis for Kathmandu Valley

[1]KC, P.C.*, [1]Rana, S.B. and [2]Khatiwada, B.

[1]*Kathmandu Valley Water Supply Management Board, Sainbu, Bhaisepati, Lalitpur*
[2]*Geo Hydro Consult Pvt. Ltd., Chapagau, Lalitpur*

*Corresponding Author: geologistprabin@gmail.com

ABSTRACT

The Kathmandu Valley, home to densely populated cities like Kathmandu, Lalitpur, and Bhaktapur, faces significant stress on its groundwater resources. With a total groundwater extraction of 114.3 MLD (KVWSMB, 2017) and high population dependency, concerns regarding groundwater depletion are a perennial topic of research and public discussion. However, most existing studies rely on data from production wells and multi-aquifer tapped wells, and a scientifically-designed, systematic monitoring network for various Hydrogeologically distinct aquifers is currently absent. This lack of a proper monitoring system makes it difficult to accurately assess the groundwater level scenario in the valley. To address this critical gap, the Kathmandu Valley Water Supply Management Board has developed a scientific and systematic groundwater monitoring network. This network is designed for real-time groundwater level monitoring using pressure sensors and telemetry. The methodology for identifying optimal monitoring well locations involved a multi-criteria analysis (MCA) using ArcGIS and the Analytical Hierarchy Process (AHP). Seventeen key factors, including geology, hydrogeology, sub-basin boundaries, potential recharge, groundwater extraction, and land use, were weighted using AHP. A weighted linear combination method was then applied to the data, resulting in the identification of 60 priority locations for the construction of the monitoring well forming a network across the valley. This initiative represents a crucial step toward a comprehensive and accurate understanding of the valley's groundwater dynamics.

Keywords: *Groundwater, Monitoring, Kathmandu, Water level, Monitoring Network.*

Groundwater Recharge and Management Works in Nepal: Case Studies from Siwalik and Bhabar Zones

[1, 2] Paudyal, K. R*., [3]Jaisi, K., [3]Thapa, M. B., [2]Chimouriya, R. and [1, 2] Sah, R. B.

[1] *Central Department of Geology, Tribhuvan University, Kirtipur, Kathmandu, Nepal*
[2]*Geo-Science Innovations Pvt. Ltd, Chandragiri-14, Kathmandu, Nepal*
[3] *Groundwater Resources and Irrigation Development Division, Chitwan, Nepal*

*Corresponding Author: paudyalkabi1976@gmail.com

ABSTRACT

This study evaluates the feasibility of artificial groundwater recharge in the Siwalik and Bhabar zones of Nepal through detailed geological and hydrogeological investigations. Twelve watershed systems of the Chure region and the Hetauda Valley, a Dun valley system, were assessed to determine groundwater status and identify potential recharge sites, with the broader goal of improving water balance and reducing the impacts of climate change. The investigated watersheds include rivers originating in the Siwalik region or just north of the Main Boundary Thrust (MBT), which flow toward the Bhabar–Terai. In the Hetauda Valley, emphasis was placed on Quaternary sediments and water-scarce areas. Fieldwork comprised geological and hydrogeological mapping, groundwater sensitivity assessments, aquifer mapping, and documentation of surface and subsurface water resources. Electrical Resistivity Tomography (ERT) surveys were carried out to determine aquifer characteristics, water table depths, and the thickness of unconsolidated deposits.

The findings reveal significant groundwater depletion and declining water availability across the study areas. Communities reported drying springs, falling groundwater levels, and the failure of traditional wells, with direct consequences for domestic supply, irrigation, and livelihoods. To address these challenges, suitable recharge sites were identified using geological logs, groundwater flow analyses, and aquifer evaluations. The study underscores the urgent need for groundwater recharge interventions. The adoption of artificial recharge structures, as recommended in the Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR) manual, is strongly advocated to enhance groundwater storage. Implementing such measures can help restore declining water levels, support community water demands, and build resilience against climate variability in vulnerable regions of Nepal.

Keywords: *Groundwater Recharge, Hydrogeology, Quaternary Deposit, Recharge Ponds, Siwalik*

Understanding Recharge Systems of Springs using δ18O Isotope in Seti Khola Watershed, Western Nepal

[1]Pokhrel G.*, [2]Rijal M. L. and [3]Krishan, G.

[1, 2]Central Department of Geology, Tribhuvan University, Kirtipur, Nepal
[3]Department of Water Resources, River Development and Ganga Rejuvenation, National Institute of Hydrology, Roorkee, India

*Corresponding Author: gunanidhi.785707@iost.tu.edu.np

ABSTRACT

The mid-hill region plays a vital role in supplying spring and surface water, much of which comes from the summer monsoon rainfall. The study focused on the western mid-hill region within the Seti Khola Watershed of Nepal, which has a subtropical to temperate climate, annual rainfall of approximately 2,500 mm, and elevations ranging from 600 to 2,300 m. The study area is geologically categorized into carbonate and non-carbonate dominant rocks, which form steep rocky terrain and soft flat land with unconsolidated soil, respectively. Given the growing need for water and better insights into groundwater recharge, this study explored new approaches to water resource assessment. Specifically, our objective was to determine how rainwater contributes to spring recharge by using stable isotope analysis of $\delta^{18}O$. In 2024, precipitation samples from two stations were collected during the monsoon, whereas 66 spring water samples were collected during the post-monsoon season. The preliminary analysis of 11, 38, and 17 springs at elevations below 1,000 m, between 1,000–1,500 m, and above 1,500 m revealed $\delta^{18}O$ values of −8.08‰, −8.21‰, and −8.88‰, respectively. In comparison, the average $\delta^{18}O$ value for precipitation was −14.05‰. These findings indicate that recharge conditions vary significantly across different altitudes and spring densities. Statistical analysis revealed that 54% of the variation in $\delta^{18}O$ could be explained by changes in elevation and the location of the sampling sites from river valleys to hilltops. Additionally, the observed altitudinal isotopic gradient of −0.12‰ per 100 m suggests that recharge altitudes for the studied springs likely range between 726 and 1,943 m.

Keywords: *Mid-Hill, Spring, Precipitation, Recharge Altitude, $\delta^{18}O$ Isotope*

Scope of Artificial Recharge of Aquifers using Induced Bank Filtration in Bangladesh

[1]Bashar, K.*

[1]*Department of Geological Sciences, Jahangirnagar University, Savar, Dhaka, Bangladesh*

*Corresponding Author: basharju@gmail.com

ABSTRACT

Induced Bank Filtration (IBF) is a type of sub-surface water intake system which is used to draw water from surface sources like rivers or lakes by filtering it through the surrounding soil and sand. It is a cost-effective pre-treatment method for producing drinking water, particularly in areas with insufficient groundwater or poor surface water quality.

Bangladesh's intricate river system, which includes the Ganges, Brahmaputra, Meghna, and their tributaries and distributaries, provides the country with vital water resources. A large portion of Bangladesh consists of an alluvial plain, a flat, low-lying region created by the accumulation of sediments like sand, silt, and clay deposited by rivers in their floodplains. IBF system can artificially recharge river bank aquifers as rivers in many parts of Bangladesh are hydraulically well connected to the underlying sandy aquifers. IBF systems have already been established on the Padma River bank at Bheramara in Kushtia district and also on the Jamuna River bank close to the Bangabandhu Jamuna Bridge in Sirajganj district of Bangladesh. It has also been planned to construct IBF system on the bank of Dhaleswari and Meghna Rivers in the southern part of Narayanganj district.

The hilly areas of Chattogram and Chattogram Hill Tracts are underlain by loose to consolidated sedimentary rocks of Tertiary age. The area is drained by numerous rivers. An IBF system has been planned to construct on the bank of Matamuhuri River flowing on the sandstone formations at Chakoria of Cox's Bazar district.

The low-lying flat coastal area of Bangladesh is characterized by intricate network of tidal channels often containing saline water. IBF is not a suitable technique for recharging aquifers in the coastal areas. It has been concluded that IBF is an efficient Managed Aquifer Recharge (MAR) technique for recharging river bank aquifers in most parts of Bangladesh excepting in the coastal areas of the Bay of Bengal.

Keywords: *Bangladesh, Groundwater recharge, Induced bank filtration, Artificial recharge*

Exploiting River Bank Filtration (RBF) for Sustainable Water Supply in the Water-Scarce Midhills of the Nepal Himalaya.

[1]Khatiwada, M.*, [1]Khanal, J., [2]Silwal, C.B., [1]Yadav, K. and [1]Rijal, N.

[1]*Department of Water Resources and Irrigation*
[2]*Department of Geology, Tri-Chandra Multiple Campus*

*Corresponding Author: zoom.mk@gmail.com

ABSTRACT

The midhills region of the Nepal Himalaya faces severe water scarcity exacerbated by climate change and rapid development, making effective water resource management crucial. While rock aquifers have historically been the primary water sources, their capacity is now strained, highlighting the need for alternative solutions like River Bank Filtration (RBF).

RBF, which filters river water through the riverbed and banks, offers a cost-effective and eco-friendly water treatment method. This study evaluates the feasibility of RBF in the midhills by analysing about 200 wells constructed since 2020, with site selection based on geospatial analysis and Electrical Resistivity Tomography (ERT).

Pumping tests reveal that rock aquifers struggle with low yield due to the rock's low permeability and transmissivity, leading to well failures. Moreover, current exploration techniques inadequately address groundwater movement through fractures and joints, making exploration costly and challenging. In contrast, RBF demonstrates significant potential for providing sustainable water yields by improving water quality and reducing reliance on seasonal monsoon rains.

Initial findings suggest RBF can offer a reliable and consistent water supply, effectively addressing water scarcity in the midhills and potentially in other Himalayan regions. Additionally, RBF could greatly benefit marginalized communities and disadvantaged groups by enhancing their access to reliable water, promoting social equity.

Successful RBF implementation could serve as a model for similar regions, improving climate resilience and supporting sustainable development. Ongoing research and pilot projects are crucial for optimizing RBF design and addressing rock aquifer challenges to ensure long-term effectiveness and integration into regional water management.

Spring Hydrogeochemistry in Diverse Lithology of Jyagdi Khola Watershed, Syangja District

[1]Neupane, P.* and [1]Rijal, M. L

[1]*Central Department of Geology, Tribhuvan University, Kirtipur, Nepal*

*Corresponding Author: prakriti.795507@cdgl.tu.edu.np

ABSTRACT

Springs in Nepal's mid-hill region serves as critical water resources controlled by monsoon dependent recharge with controlling factors of geological and geomorphological settings. The study focuses on the western mid-hill region within the Jyagdi Khola Watershed of Syangja, Nepal, which has a subtropical to temperate climate, annual rainfall of approximately 2,218 mm, and elevations ranging from 326m to 1714 m. The study area is geologically categorized into carbonate and non-carbonate dominant rocks, which form steep rocky terrain and flat land with unconsolidated soil, respectively. To understand the geological influence on spring distribution and discharge pattern, this study investigates approaches to assess spring water chemistry. The analysis shows that spring density decreases with increasing elevation, with the highest concentration of springs occurring below 1000m (22 springs), moderate density between 1000-1500m (14 springs), and sparse distribution above 1500m (1 spring).Spring discharge is highest in mid-elevation zones (800–1200m), contributing 50% of total flow (186.62 l/min), while low-elevation springs (<800m) show high variability and high-elevation springs (>1200m) yield minimal discharge due to limited recharge. Spatial analysis revealed that elevation, slope, and aspect play critical roles in spring distribution, with moderate slopes (18°–54°) and SE- or NW-facing aspects being most favorable. The spring water chemistry in the study area is dominated by Ca^{2+} (4–92.89 mg/l) and Mg^{2+} (1.19–30.62 mg/l) as primary cations, and HCO_3^- (30.5-353.8 mg/L) as the dominant anion, reflecting dissolution of carbonate rocks. These findings indicate that springs in carbonate rocks (Dhading Dolomite) are characterized by high concentrations of calcium (Ca^{2+}: 40-93 mg/l), magnesium (Mg^{2+}: 12-31 mg/l), and bicarbonate (HCO_3^-: 250-354 mg/l), resulting from carbonate mineral dissolution. In contrast, springs in non-carbonate rocks (phyllite/slate/alluvium) show elevated sodium (Na^+: 25-40 mg/l), potassium (K^+: 10-20 mg/l), and chloride (Cl^-: 6-60 mg/l), indicating silicate weathering.

Keywords: Spring Discharge, Hydrochemistry, Middle Hill, Hard-Rock Aquifer, Carbonate Rock

Application of Oneway Valve for the Management of Groundwater in Tunnelling of Nepal Himalaya

[1]Chaulagai, K.* and [2]Dahal, R.K.

[1]*Underground Space Engineering Pvt. Ltd.*
[2]*Central Department of Geology, Tribhuvan University*

*Corresponding Author: geologistkanchan@gmail.com

ABSTRACT

Ground water play vital role in the tunnel execution in the Nepal Himalaya. Low, medium and high groundwater ingress has been observed during the construction of tunnel. The nature of flow and associated rockmass has significant effect on the tunnelling. The combination of low flow with good rockmass does not hamper in the tunnel excavation. High flow with weak rock mass has great impact on the tunneling which lead to huge overbreak in the construction Phase. Challenges of groundwater management still remains in the operation phases. Installation of oneway valve may be one rapid solution. Its installation manage groundwater ingress in the tunnel during operation as well as it also plays vital role in the revenue generation.

Keywords: *Groundwater, Management, Tunnelling, Hydropower, Oneway Valve*

Water Poverty Index and Groundwater Potential Delineation to Mitigate Geo-Environmental Disasters at the Lower Reaches of the Manahar Khola Watershed, Makwanpur District

[1]Paudel, A., [2]Pandey, K. and [3]Pathak, D.*

[1]*University of Waikato, Hamilton, New Zealand*
[2]*Community Self Reliance Centre (CSRC)*
[3]*Central Department of Geology, Tribhuvan University, Kirtipur, Kathmandu, Nepal*

*Corresponding Author: anjanapaudel28@gmail.com

ABSTRACT

Groundwater, though a dependable and valuable resource, is difficult to access in mountainous regions. This study, carried out in the lower Manahari Khola watershed, spans ten wards within Raksirang and Kailash Rural Municipalities. It aims to conduct a spring inventory, assess drinking water quality, and map water scarcity and availability using the Water Poverty Index (WPI) and groundwater potential mapping. Field observations documented spring type, source, discharge, surrounding geology, land use, and flow consistency, followed by physicochemical analysis of collected water samples. Fracture springs were identified as the most common type in the area. Groundwater potential mapping was developed using thematic layers from satellite imagery and GIS, with ranking and weighting determined through the Analytical Hierarchical Process. Validation with data from 48 springs, analysed using IBM SPSS, yielded a 77.8% AUC prediction accuracy. The groundwater potential map classified areas into low (0–40%), moderate (40–60%), and high (60–100%) potential. WPI mapping incorporated field-collected data for its five components; resource, access, capacity, environment, and use. Results showed that Dumre, Khanidanda, and Tamlan possess both high groundwater potential and high WPI scores, indicating strong water availability. In contrast, Chamanti, Kutsin, Chainpur, Likche, and Chyakhe displayed low groundwater occurrence and low WPI values, designating them as water-scarce zones.

Keywords: *Groundwater, Spring, Water Quality, WPI, Groundwater Potential Zone, AHP*

Delineation of Groundwater Potential under Projected Climatic Conditions in Kankai River Basin, East Nepal Himalaya

[1]Silwal, C.B.*, [2]Nepal, M., [2]Karkee, B., [2]Dahal, K., [2]KC, M. and [2]Pathak, D.

[1]*Department of Geology, Tri-Chandra Multiple Campus, Tribhuvan University, Ghantaghar, Kathmandu, Nepal*
[2]*Central Department of Geology, Tribhuvan University, Kirtipur, Kathmandu Nepal*

*Corresponding Author: champak.silwal@trc.tu.edu.np

ABSTRACT

This study focuses on groundwater potential under the projected climatic conditions within the Kankai River Basin (KRB) in Eastern Nepal. This basin spans diverse landscapes from the Mahabharat Range to the Indo- Gangetic Plains (IGP) and considered as a crucial source of water, supporting the socio-economic development of this region.

The primary objective of the study is the assessment of climate change and evaluate its impact on GWP across the basin. This study employs a multicriteria approach, incorporating different factors in an Analytic Hierarchy Process to generate the groundwater potential maps. Further the basin was disintegrated HHC, Siwalik, and IGP, and analysed separately.

The findings indicate that 66% of the basin lies within very low to moderate followed by 33% high to very high potential zones. The areas with higher potential area are primarily distributed along the plains and lower elevations, where the aquifer recharge is facilitated by permeable soils, favourable geology, and high rainfall. Conversely, the mountainous regions exhibit low potential due to steep slopes, poor recharge conditions, and lower rainfall retention.

The study utilizes future climate projections under the scenario of RCP 8.5 to evaluate its impact on groundwater availability. The analysis shows that the KRB has already experienced changes in the temperature and pattern of rainfall, and these trends are expected to intensify in the future to cause a declination in groundwater availability, particularly along high-altitude and mountainous region during 2030s. This decline is expected to be most severe in the 2030s, with a gradual recovery towards the 2090s.

The research concludes by emphasizing the importance of integrating groundwater management into the broader framework of climate change adaptation and sustainable development. The KRB, like many other basins, is particularly susceptible to the effects of changing climate, making the sustainable management of its groundwater resources vital for long-term social and economic stability.

Keywords: *Climate Change, Precipitation Projection, GIS and Remote Sensing, Analytical Hierarchy Process, Groundwater Availability*

Citizen Science-Based Shallow Groundwater Monitoring in the Kathmandu Valley

[1,2]Mandal, R.B.*, [1]Adhikari, S., [1,3]Acharya, S., [1]Rijal, K. and [1]Duwal, S.

[1]*Smartphones For Water Nepal (S4W-Nepal), Lalitpur, Nepal*
[2]*Khwopa College, Bhaktapur, Nepal*
[3]*Central Department of Environmental Science, Tribhuvan University, Kathmandu, Nepal*

*Corresponding author: rohinee@smartphones4water.org

ABSTRACT

Groundwater is a vital water resource in Kathmandu Valley (Valley), supplying 60-70% of the Valley's total water supply demand. However, changing land use, over-extraction, and pollution have led to both quantitative and qualitative degradation of the groundwater resources. Therefore, a preliminary step of understanding and managing the groundwater resources is to monitor them. To address this, Smartphones For Water Nepal (S4W-Nepal) has been monitoring shallow groundwater levels since 2017 by leveraging citizen science, young researchers, and mobile technology. This study utilized monthly below-ground level (bgl) data from 59 shallow wells, collected from 2017 to 2024, to investigate level fluctuations along with a water quality analysis in 2023. The result showed that the northern and eastern parts of the Valley were found to have a generally shallower groundwater level, while the more urbanized central part had deeper groundwater levels all year round. Groundwater levels were shallower during the monsoon and post-monsoon months but deeper during the pre-monsoon and winter seasons. A water quality index analysis showed 32% of the wells had water unsuitable for drinking purposes, 14% had very poor water quality, 10% had poor water quality, and 24% of the wells had good water quality. This study highlights the seasonal and spatial groundwater level changes, underscoring a significant water quality issue where over half of the wells tested were found to be poor or unsuitable for drinking.

Keywords: *Groundwater, Kathmandu Valley, Citizen Science, Water Quality Index (WQI).*

Geospatial Assessment of Groundwater Potential, Utilization and Recharge Status in Koshi Province, Nepal

[1]Shah, S. and [1]Bista, M.*

[1] *Groundwater Resources and Irrigation Development Division, Koshi Province, Biratnagar, Nepal*

*Corresponding Author: surendra_shah@hotmail.com

ABSTRACT

Groundwater is the world's most vital freshwater source, providing 50% of global drinking water and 40% of irrigation water, yet it remains undervalued and threatened by climate change, population growth, and unsustainable use. In Nepal, the southern Terai region, a part of the larger Gangetic basin, is home to over 53% of the country's population and holds abundant groundwater resources crucial for agricultural development and food security. Despite a high national irrigation potential, only a fraction of this land is currently irrigated, with groundwater contributing to one-third of the total. In Koshi Province, only 53% of cultivable land is irrigated, with a significant portion lacking a year-round water supply. While the province possesses an estimated annual renewable groundwater resource of 2.43 billion cubic meters (BCM), there's a vast gap between this potential and current utilization, as only about 51,000 hectares are irrigated by groundwater. The recent drought in the Terai, exacerbated by a lack of rainfall and environmental degradation in the Churia Hills, has caused a critical decline in groundwater levels, with shallow aquifers failing to recharge. This highlights the region's vulnerability and the critical importance of mountain front recharge from the Chure and Mahabharat ranges. Given the varied estimates and lack of comprehensive data on recharge and abstraction, this study aims to assess groundwater potential, use patterns, and overall recharge status in the Terai region of Koshi Province. Using geospatial techniques, the research will specifically quantify the contribution of mountain front recharge, which is essential for developing a sustainable groundwater management strategy.

Keywords: *Groundwater Potential, Groundwater Recharge, Mountain Front Recharge, Mahabharat Range.*

Groundwater Potential Assessment using Geospatial Method in the Central Hetauda Valley

[1]Kafle, D., [1]Gautam, U. and [1]Pathak, D.

[1]*Central Department of Geology, Tribhuvan University, Kathmandu, Nepal*

*Corresponding Author: kafledivya4@gmail.com

ABSTRACT

The ever-increasing water demand and water security, exacerbated by rapid population growth and urbanization have pressurized the water quality and quantity of water resources, especially in Hetauda, a key administrative city of central Nepal. With surface water resources declining due to over-exploitation as well as pollution, groundwater has emerged as a critical alternative for meeting the water demand. This study aims to assess groundwater potential of the central parts of the Hetauda valley. This study utilizes the Analytical Hierarchy Process (AHP) to determine the groundwater potential across the study area by incorporating hydrogeochemical data from thirty-four groundwater samples. AHP is a multi-criteria based decision- making method that integrates spatial data and expert opinion. Groundwater potential zones were mapped based on seven parameters including, slope, drainage density, lineament density, land use and land cover (lulc), geomorphological features and geology. The thematic parameters were assigned weightages and ranks based on their potential influence on groundwater occurrence, which were then integrated using the AHP method to create a comprehensive groundwater potential map. It was observed that the majority of the groundwater potential zones were concentrated in the central portion of the valley (study area), whereas the eastern part of the valley comprised lower potential zones. This study offers a valuable insight for identification of viable areas for groundwater exploration for effective and sustainable management of groundwater resources in the study area.

Keywords: *Groundwater Potential (GWP), Analytical Hierarchy Process (AHP), Groundwater resource management, Groundwater sustainability, Spatial Analysis*