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## Decoding the Impact of LULC Changes on Groundwater Recharge in Western India

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Groundwater recharge is significantly influenced by anthropogenic activities, particularly changes in land use and land cover (LULC). These long-term temporal and seasonal LULC changes alter groundwater flow dynamics, necessitating their assessment for sustainable groundwater resource management. This study investigates the effects of LULC changes on groundwater recharge processes in the sub-watershed of the Nira River, Maharashtra, India. Using Google Earth Engine, LULC classifications were generated from Sentinel-2 satellite imagery acquired over a decadal period (2014–2024). A change detection algorithm was employed to decipher the long-term spatio-temporal LULC patterns, complemented by seasonal analysis using LULC maps of wet and dry months. Historical data from government agencies and private entities validated these findings, strengthening the analysis.

The results indicate a 4.6% increase in built-up areas and a 5.7% decrease in forest cover over the analysis period. Rainfall data from 2015 to 2024 was correlated with groundwater level records, revealing enhanced recharge in 2024 compared to 2014. This improvement is attributed to increased rainwater harvesting structures observed during the assessment period, contributing significantly to recharge in dug wells. Seasonal LULC variations also influenced recharge dynamics, with the dry season showing higher recharge potential compared to the wet season. These findings provide critical insights into the interplay between LULC changes, groundwater recharge processes, and sustainable water resource management in the study area.

**Keywords:** LULC, impact assessment, Groundwater recharge, Western Deccan Basalt, India