Geospatial technology in groundwater recharge potential assessment using multi-criteria decision-making approach

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Many regions in India and worldwide are currently grappling with or have experienced water crises, primarily due to frequent droughts, expanding agricultural land, and excessive groundwater abstraction. The primary objective of present study is to map groundwater recharge (GWR) potential in hard rock-dominated terrain. The approach involves an ensemble of techniques, combining an integrated analytic hierarchy process with the geographic information system. Various hydrogeological and groundwater-controlling factors, including geology, slope, geomorphology, depth to water level, soil types, normalized difference vegetation index, land use/land cover and drainage density were mapped and assessed using satellite data and field verification. The methodology was applied in the Chhindwara region in the southern part of Madhya Pradesh, India, where the geological composition is predominantly hard rocks. The outcomes of this study can be utilized for GWR potential mapping, land-use planning, rainwater harvesting and formulating groundwater development plans.

Keywords: Geospatial technology, groundwater recharge, multi-criteria analysis, rainwater harvesting, water scarcity.

population living in big urban and sub-urban areas mostly depends on groundwater resources for domestic and irrigation purposes, and the availability of potable water in many cities of India has become a perpetual problem[4–6]. In a report by NITI Aayog[7], the Government of India has highlighted that many parts of the country are facing severe deficiency of potable groundwater, and its availability is expected to become worse by 2030; hence, proper measures must be taken urgently. It has been observed during the last two decades that large-scale changes in land-use practices and haphazard urban growth have adversely affected the groundwater recharge potential of the top aquifer formation due to increased surface run-off and reduced water infiltration[8]. In this situation, analysing aquifer formation for identifying potential groundwater recharge zones in hard-rock terrain is a big challenge for hydrogeologists. The hard-rock crystalline terrains have very low groundwater prospects. However, in the case of secondary porosity, including structures and weathered thickness of aquifer material, it can provide good prospects of groundwater resources. The potential aquifers have not been demarcated and idealized appropriately in most areas due to a lack of required data and a poor understanding of their hydrogeo-