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GIS-based techniques for identification of potential artificial recharge areas in Kabul River basin, Afghanistan

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Under climate change conditions, arid and semi-arid regions need facing challenges of sustainable water resources management. Climate change in these regions is the accelerator of extreme events (droughts and flash floods) and the increase of water scarcity issues. Afghanistan is a landlocked country which is located in the south of Asia. Kabul River Basin (KRB) is the most populous region in the country. The total catchment area of KRB is about 108000 km^2. The elevation ranges between 260 and 7600 m a.s.l.. There are some major tributaries in the basin such as Kabul, Logar, Kunar, and Panjsher. The study area has a semi-arid climate. In the Central Kabul sub-basin (capital of the country) the groundwater is more prone to declination due to the rapid population increase of internal displacement people. The groundwater is significantly affected by anthropogenic alterations especially in the Central Kabul sub-basin areas of the river basin. Groundwater overexploitation, droughts, and rapid population increase are among common phenomena in the KRB which greatly affect the availability of water resources. The domestic water supply for the city of Kabul is entirely dependent on groundwater. The city with an average per capita water supply of 20 l/day is among the most water-stressed cities in the world. Artificial Recharge (AR) applications can be used to mitigate these phenomena. Due to the highest evapotranspiration rate, special attention indeed, has been paid to AR in water resource management in arid and semi-arid regions.

In this study, a detailed literature review on the existent AR types suitable for arid and semi-arid region and Geographic Information System (GIS) techniques, are used to identify the most suitable AR areas in the KRB. The hydrological behaviour of AR is investigated and the design criteria are defined. Infiltration, evapotranspiration, retention capacity and other hydrological parameters connected with hydraulic risk, underground recharge, soil moisture, and run-off are particularly analysed. Some parameters including topography, geology, hydrography, climate variables, existing water infrastructures, and demography are used for the identification of potential AR areas in the KRB. The analysed parameters are classified, weighted, and thematic maps are developed in GIS environment.

The implementation of AR could bring great benefits to the basin especially as far as the groundwater resources enhancement for domestic water supply and irrigation is concerned. The groundwater of the KRB is about 70% and 60% vulnerable to droughts and floods respectively. The

groundwater recharge rate of the basin is about 90 mm/year. The use of Karez, springs, and wells are responsible for the overexploitation of the groundwater in the KRB. Suitable AR types and suitability maps of the study area are developed. The developed map can be used as a tool for the future implementation of AR techniques in the KRB. KRB is a trans-boundary river basin in which a part of the river basin is located in Pakistan. In trans-boundary water resources management, some measures should be taken to prevent water-related dispute issues.