AN INTEGRATED GEOPHYSICAL AND REMOTE SENSING APPROACH TO EXPLORE AND MODEL SUBSURFACE GROUND WATER; QUETTA A CASE STUDY

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Abstract

Quetta valley is an essential geological entity of Quetta Basin which is located in Baluchistan, Pakistan. The climate is typical desert to semi desert elsewhere, low rainfall (~100 mm/yr) and extreme temperature variations. The rapid increase in population, quick rise of annual mean temperature and low precipitation bring Quetta into serious water problem. Water scarcity leads this project to address this need for assessment, exploration, mapping and development of groundwater resources. The area is diversely studied in terms of Geology, Geophysics, Remote sensing, Geochemistry, Drilling, and Probabilistic modeling, for potential water reservoirs. Quetta Valley consists of a tectonic depression, buried valley, and karstic bedrock. Rock formations range from Jurassic to recent alluvium deposits mostly limestone and shales. The extensive faulting and jointing suggest opportunities for groundwater entrapment in these fractured systems. To evaluate these sweet zones an integrated set of remote sensing, Geological and Geophysical data are used. The remote sensing data include Landsat TM Mosaics, Digital Topography (SRTM 30m) and spatial drainage patterns. The geological data includes geologic maps, fault maps and soil maps. Based on that data surface water movement, their possible storage and potential to be future Aquifer are modeled for the Quetta and surrounding areas. The geophysical studies are involved in surface water exploration and modeling. The Electromagnetic (EM) data is used to find out the subsurface faults and lithology types. Based on EM data, the subsurface lithology of Quetta is divided into different zone in term of water bearing potential, keeping in view the fractures and faulting systems. The Resistivity survey successfully marked subsurface reservoir zones. The data model shows that northern part of the Quetta is a depression as compare to southern part. There are some local depressions which also act as reservoir in southern most proximity. Aquifers are located near the foothills of the Murdar and Mian Ghundi regions. In the NW part of the Quetta valley, there is a 10 km wide water gap between Saumungli and Baleli, which connects the Quetta Basin with Bostan-Pishin Plain. The drainage of the Quetta Basin finds its way out through this gap and joins the Pishin Lora River. To the NE of Quetta there is gap which connects Quetta to Kach Basin.The area is faulting and fracturs bear good potential for water. In Subsurface, there are three water bearing zones in unconsolidated alluvium. The carbonates, which is Jurassic Chiltan limestone also act as reservoir but due to thick unconsolidated alluvium succession it is difficult to reach these reservoirs. Furthermore, the publish observation data shows that water level is depleting here with a rate of 1m/year in south and 1.5m/year in north in unconsolidated alluvium while carbonate depletion rate is 4-6m/year.