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3D Numerical Groundwater Flow Modeling in Kohat Sub Basin, Northwest Himalayan Fold & Thrust Belt Pakistan

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Abstract

Groundwater has emerged as an exceedingly important water resource and its increasing demand in agriculture, domestic and industrial uses ranks it as a resource of strategic importance. Pakistan is blessed with extensive groundwater resource, which has been built due to direct recharge from natural precipitation, river flow, and the continued seepage from the conveyance system of canals, distributaries, watercourses and application losses in the irrigated lands during the last 90 years. The present and future groundwater availability and exploitation has been evaluated in an intermountain basin (Kohat Sub basin) of Northwest Himalayan Fold & Thrust belt Pakistan by developing 3D Numerical Groundwater flow models. Numerical Groundwater Flow Modeling is used to characterize complex hydrological systems and to predict future availability of fresh water resources. To support the study some geophysical, hydrological and metrological data of entire basin including canals and river flow was used. The finite-difference groundwater modeling program (MODFLOW) developed by USGS was used for simulating the three-dimensional groundwater flow of the Kohat Basin to investigate different water management strategies, the output of modeling program resulted in groundwater flow pattern which closely resembles the natural flow pattern in the study area. The litholgical succession of alluvial cover in the study area is very heterogeneous, consequently three continuous layers of coarse sand, gravel sand mixed facies and boulder sand respectively were selected for conceptual model construction. The hydraulic heads of from nine observation wells were used as initial conditions for steady State simulation, the model successfully calibrated with 95% confidence interval and 0.99 correlation coefficient. The steady state model show that under no stress condition the groundwater is flowing from northeast and northwest to southeastern parts of the study area. In order to understand the impact of stress periods on groundwater, the transient simulation was run which successfully generated the heads for the predicted year 2018. The groundwater withdrawal exceed the recharge, consequently the result shows that water table has been dropped by 25 meters, the continues withdrawal of groundwater and mismanagement may lead to critical condition regarding water availability in the study area. It is thus recommended to maintain the safe yield in vulnerable zones e.ge. Northeastern and southern parts of the study area. The groundwater is almost fresh with good quality; the only precaution is SAFE YIELD.

Keywords: Numerical Modeling, Groundwater Flow, Kohat basin, Groundwater, MODFLOW

Note: *The 3D Numerical Groundwater flow Models for the first time have been constructed in the study area, it provided very productive results and submitted the predictions to Provincial Water Development Authority to work on the proposed strategies resulted from Modeling results. Hope this would be very helpful in future water exploration and exploitation in Kohat Sub Basin of Pakistan.*