World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:9, No:02, 2015

Vulnerability Assessment of Groundwater Quality Deterioration Using PMWIN Model

Authors : A. Shakoor, M. Arshad

Abstract : The utilization of groundwater resources in irrigation has significantly increased during the last two decades due to constrained canal water supplies. More than 70% of the farmers in the Punjab, Pakistan, depend directly or indirectly on groundwater to meet their crop water demands and hence, an unchecked paradigm shift has resulted in aquifer depletion and deterioration. Therefore, a comprehensive research was carried at central Punjab-Pakistan, regarding spatiotemporal variation in groundwater level and quality. Processing MODFLOW for window (PMWIN) and MT3D (solute transport model) models were used for existing and future prediction of groundwater level and quality till 2030. The comprehensive data set of aquifer lithology, canal network, groundwater level, groundwater salinity, evapotranspiration, groundwater abstraction, recharge etc. were used in PMWIN model development. The model was thus, successfully calibrated and validated with respect to groundwater level for the periods of 2003 to 2007 and 2008 to 2012, respectively. The coefficient of determination (R2) and model efficiency (MEF) for calibration and validation period were calculated as 0.89 and 0.98, respectively, which argued a high level of correlation between the calculated and measured data. For solute transport model (MT3D), the values of advection and dispersion parameters were used. The model used for future scenario up to 2030, by assuming that there would be no uncertain change in climate and groundwater abstraction rate would increase gradually. The model predicted results revealed that the groundwater would decline from 0.0131 to 1.68m/year during 2013 to 2030 and the maximum decline would be on the lower side of the study area, where infrastructure of canal system is very less. This lowering of groundwater level might cause an increase in the tubewell installation and pumping cost. Similarly, the predicted total dissolved solids (TDS) of the groundwater would increase from 6.88 to 69.88mg/L/year during 2013 to 2030 and the maximum increase would be on lower side. It was found that in 2030, the good quality would reduce by 21.4%, while marginal and hazardous quality water increased by 19.28 and 2%, respectively. It was found from the simulated results that the salinity of the study area had increased due to the intrusion of salts. The deterioration of groundwater quality would cause soil salinity and ultimately the reduction in crop productivity. It was concluded from the predicted results of groundwater model that the groundwater deteriorated with the depth of water table i.e. TDS increased with declining groundwater level. It is recommended that agronomic and engineering practices i.e. land leveling, rainwater harvesting, skimming well, ASR (Aquifer Storage and Recovery Wells) etc. should be integrated to meliorate management of groundwater for higher crop production in salt affected soils.

Keywords : groundwater quality, groundwater management, PMWIN, MT3D model
Conference Title : ICSWRM 2015 : International Conference on Sustainable Water Resources Management
Conference Location : London, United Kingdom
Conference Dates : February 16-17, 2015

Open Science Index, Environmental and Ecological Engineering Vol:9, No:02, 2015 publications.waset.org/abstracts/15225.pdf