

The vulnerability evaluation of groundwater level rising and development of irrigation network in Mian-Ab aquifer through Analytical Hierarchical Process method and groundwater modeling

Seyed Yahya Mirzaee Arjanki^{a,*}, Pooria Sheikhy^b, Manouchehr Chitsazan^c

^aEarth Sciences Faculty, Shahid Chamran University of Ahvaz, Iran, Tel. +98613331059; Mobile: +989163096940; Fax: +98613331059; email: Yahyamirzaee@scu.ac.ir

^bMSc of Hydrogeology, Abatipajoooh Consulting Engineering Company, Ahvaz, Iran, email: Pooriasheikhy@yahoo.com

^cEarth Sciences Faculty, Shahid Chamran University of Ahvaz, Iran, email: Chitsazan-m@scu.ac.ir

Received 28 January 2022; Accepted 12 July 2022

ABSTRACT

Groundwater level rising in the plain of Mian-Ab located in Khuzestan Province, southwestern Iran, is one of the major threats to this region. Continuous recharge of the aquifer through returned water from irrigation canals as well as the spread of fine sediment particles along with other hydrological and hydrogeological factors have led to a decrease in groundwater quality and waterlogging of the areas under cultivation in the region. This study evaluated nine important hydrological and hydrogeological parameters using the Analytical Hierarchical Process method to detect the vulnerable zones in Mian-Ab aquifer regarding the groundwater level rising. The vulnerability map showed that some parts of northern, central and southern lands in the study area were in the medium and high waterlogging vulnerability. The groundwater flow in the aquifer was then simulated using the MODFLOW model to validate and verify the vulnerability map of the study area, and also to predict the aquifer behavior in case of developing an irrigation canal network in future. The model was calibrated from September 2016 to September 2017 in the unsteady state conditions with 0.94 RMSE error. The model was first executed with a 20 percent increase in the net recharge rate. Then, the vulnerability map was confirmed and validated in the MODFLOW model, given that the increase in groundwater level occurred precisely in the zones identified in the vulnerability map. In the next step, to evaluate the development of the irrigation network in the region, the future conditions were simulated therein. The model showed that the head would increase significantly about 2 to 4 m in the same zones where the vulnerability map detected, and the recharge rate increased about 13.28 MCM through the returned water of the future canals considering their dedicated specific flow rates. It is thus recommended that the network development program and net recharge allocation be adequately managed to prevent environmental problems in the southern parts of the study area.

Keywords: Groundwater level rising; Analytical Hierarchical Process; Geographical Information System; MODFLOW 2000; Groundwater Modeling System; Mian-Ab

* Corresponding author.