

Seasonal groundwater quality change with intensive pumping in an agricultural area, Korea

KYOOCHUL HA^{*1}, KYUNG-SEOK KO¹, EUNHEE LEE²

¹*Korea Institute of Geoscience and Mineral Resources*, ²*Korea Institute of Geoscience and Mineral Resource*

(a) Purpose of study or research hypothesis

There may be many cases showing that groundwater quality changes due to groundwater pumping. However, few studies have considered both groundwater level fluctuations and quality at the same time. This study was conducted to observe seasonal groundwater quality due to pumping and to evaluate hydrochemical characteristics with groundwater level variations in an agricultural area where groundwater is used intensively at specific times. Particularly, rice paddies in Korea requires a lot of water in the summer, and if it rains less in that time, groundwater will be used more for irrigation. Therefore, it is required to evaluate the groundwater quality in different seasons through long-term monitoring for groundwater levels and hydrochemical analysis.

(b) Key issue(s) or problem(s) addressed

In Korea, precipitation is concentrated in summer and varies greatly from season to season. In areas where there is a lot of rice paddy farming, irrigation water in the summer is in high demand. If it rains less during that time, irrigation water should be drawn from other areas, or secured from groundwater by developing wells in the area. When groundwater is pumped, its quality before and after pumping may change with the seasons. As groundwater pumping continues, the quality may change, which is caused by mixing from different aquifers, inflow of surface water from rivers or reservoirs, seawater intrusion, and so on. Also, groundwater quality may change temporally due to hydrologic processes, including seasonally variable rainfall and irrigation patterns.

(c) Methodology or approach used

To evaluate seasonal changes in groundwater quality, 55 wells were identified on site in the study area, and 25 wells were selected for investigation. Groundwater level fluctuations are mainly caused by factors such as precipitation, groundwater pumping, tides, and so on. In the study area, long-term observations of groundwater levels are necessary because pumping for irrigation is expected to have effects. Automatic water level and quality monitoring sensors (TD-Diver, Van Essen Instruments) were installed at 20 monitoring wells to see the relationship between groundwater level fluctuations and pumping effect around the wells. Groundwater level monitoring was done automatically at 10 minute intervals for approximately 1 year from September 2018 to September 2019. The automatic monitoring data were corrected by manually measured groundwater levels once a month.

(d) Results or conclusions derived from the project

Groundwater use in the area is closely related to irrigation for rice farming, and rising groundwater levels occur during the pumping, which may be caused by the irrigation water of rice paddies. Hydrochemical analysis results for two separate times (17 July and 1 October 2019) show that the dissolved components in groundwater decreased overall due to the effect of dilution, especially at wells in alluvial aquifer and shallow depth. Variations of water quality types among Ca-HCO₃, Ca-Cl, Na-HCO₃, and Na-Cl types were also shown at some wells. In addition, the groundwater quality was confirmed to still have the effect

of saltwater supplied during the 2018 drought by comparison with seawater. According to principal component analysis (PCA), the water quality from July to October was confirmed to have changed due to dilution, and the effect was strong at shallow wells.

(e) Implications of the project relevant to congress themes

In the study areas where rice paddy farming is active in summer, irrigation water may be one of the important factors changing the groundwater quality.

Keywords : Groundwater, quality, Irrigation, pumping, agricultural area