ABSTRACT

This study evaluates the effectiveness of a Managed Aquifer Recharge (MAR) system implemented in Dong Khwang village, Sakon Nakhon Province, Northeastern Thailand, as a response to the growing challenge of water scarcity affected by climate change. By employing field observations, hydrogeological data, and numerical groundwater modelling using MODFLOW via ModelMuse, the research simulates groundwater conditions both with and without the MAR system over a ten-year period. The study area is characterised by unconfined and unconsolidated aquifers, which have low permeability, along with variable rainfall and high evapotranspiration rates, which limit natural recharge. Model calibration, which involved manual parameter adjustment, achieved a root mean square residual (RMSR) of less than 1.3 m, confirming model reliability. Results indicate that the MAR system significantly enhanced the groundwater resources, reversing the future decreasing resources (-0.39 Mm^3) to an increase of 0.88 Mm^3 by 2034. This represents an additional 1.26 Mm^3 compared to natural conditions, with the maximum increase in water level reaching 0.57 m. Additionally, 12,310 m^3/year of water is now available to support the domestic consumption needs of 684 residents, and more than 72,190 m^3/year is still available for agriculture during the dry season. Furthermore, the MAR has influenced groundwater flow across an area of approximately 1.3 km^2, with water travelling up to 2.7 km from the system by 2034. These findings confirm that MAR represents a viable solution for sustaining groundwater levels in drought-prone regions and support its integration into long-term water resource planning in Thailand.