Spatio-temporal potential future drought prediction using machine learning for time series data forecast in Abomey-calavi (South of Benin)

Agossou Amos*, Kim Do Yeon**, Yang Jeong-Seok***

Abstract

Groundwater resource is mostly used in Abomey-calavi (southern region of Benin) as main source of water for domestic, industrial, and agricultural activities. Groundwater intake across the region is not perfectly controlled by a network due to the presence of many private boreholes and traditional wells used by the population. After some decades, this important resource is becoming more and more vulnerable and needs more attention.

For a better groundwater management in the region of Abomey-calavi, the present study attempts to predict a future probable groundwater drought using Recurrent Neural Network (RNN) for future groundwater level prediction. The RNN model was created in python using jupyter library. Six years monthly groundwater level data was used for the model calibration, two years data for the model test and the model was finaly used to predict two years future groundwater level (years 2020 and 2021). GRI was calculated for 9 wells across the area from 2012 to 2021. The GRI value in dry season (by the end of March) showed groundwater drought for the first time during the study period in 2014 as severe and moderate; from 2015 to 2021 it shows only moderate drought. The rainy season in years 2020 and 2021 is relatively wet and near normal. GRI showed no drought in rainy season during the study period but an important diminution of groundwater level between 2012 and 2021. The Pearson's correlation coefficient calculated between GRI and rainfall from 2005 to 2020 (using only three wells with times series long period data) proved that the groundwater drought mostly observed in dry season is not mainly caused by rainfall scarcity (correlation values between -0.113 and -0.083), but this could be the consequence of an overexploitation of the resource which caused the important spatial and temporal diminution observed from 2012 to 2021.

Keywords : GRI, Pearson correlation, groundwater drought

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* PhD student. Dept. of Civil and Environ. Eng., Kookmin University · E-mail : amosagossou2020@kookmin.ac.kr

** Student, Dept. of Civil and Environmental Engineering Kookmin University

*** Professor, Dept. of Civil and Environmental Engineering, Kookmin University