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Application and validation of artificial neural network model to groundwater productivity-potential mapping

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Table 1. Input factors and weights value of each factor.

Factor	Mean
Ground Elevation	0.041
Ground Elevation within 300m	0.052
Forest Density	0.048
Bedrock Geology	0.041
Groundwater Depth	0.069
Groundwater Gradient	0.043
Hydrogeology	0.043
Lineament Frequency Density	0.042
Lineament Length Density	0.047
Lineament Weighted by its Frequency Density	0.046
Lineament Weighted by its Length Density	0.045
Density for Lineament Cross Points	0.043
River Density	0.041
River Distance	0.051
Ground Slope	0.059

This study analysed groundwater productivity-potential using a data-mining classification model such as an artificial neural network (ANN) in a geographic information system (GIS) in Boryeong city, Korea.

Ground Slope within 300m	0.051
Soil	0.040
Stream Power Index	0.055
Watershed Area	0.043

The model was based on the relationship between groundwater-productivity data, including specific capacity (SPC) from 72 well locations,, and its related hydrogeological factors (*Table 1*). Data for related factors, including topography, lineament, geology, and forest and soil, were collected and input into a spatial database. The SPC values of < 4.55 $m^3/d/m$, corresponding to a yield of 300 m^3/d, were used as criteria for GPP.

The ANN model was used to map groundwater productivity-potential (GPP). In the ANN model, a back-propagation algorithm was applied and the resulting GPP map was created (*Figure 1*). Finally, the GPP map was validated using area-under-the-curve (AUC) analysis with the well data that had not been used for training the model. The ANN model had accuracies of 83.57%.

To assess the weight (importance) of the factors, the weights were calculated in ANN (*Table 1*). As a result, "Groundwater Depth", "Forest Density", "Ground Slope", "Ground Elevation within 300 m", and "Ground Slope" were found to have relatively more weight, whereas "Bedrock Geology", "Lineament Frequency Density", and "Soil" had relatively less weight on the GPP maps. These results indicate that the ANN model could be useful for the development of groundwater resources.

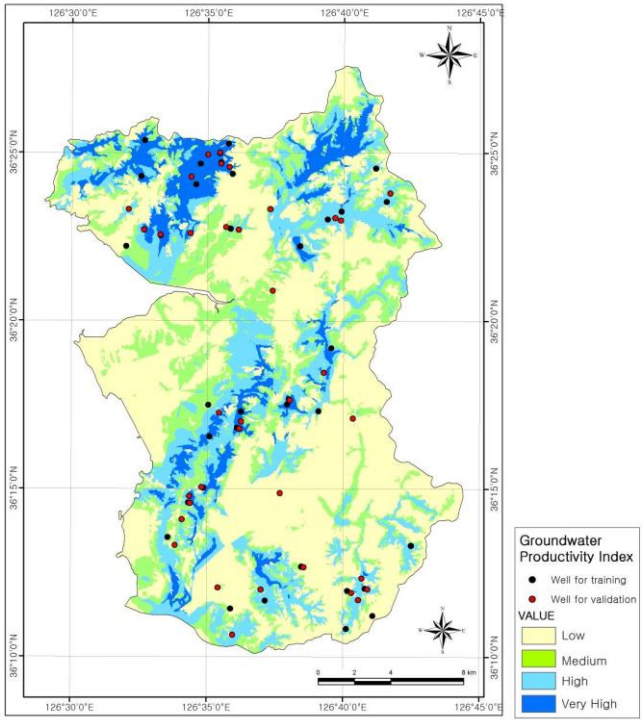

Figure 1: Groundwater productivity potential map created using artificial neural network. The index was classified into very high (10%), high (20%), medium (20%), and low (50%) index ranges of the study area.