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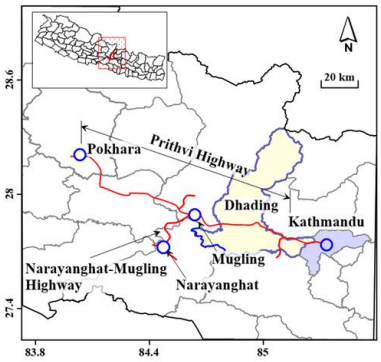
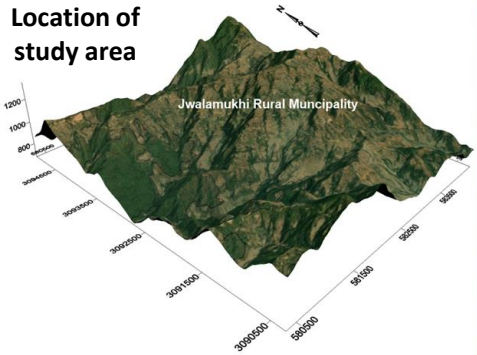
Identification of Groundwater Potential zones in Mountainous area based on Topo-hydro indices and Presence-only Method

Background

A large section of population in mid-hills of Nepal is benefited from the use of groundwater resources in domestic, irrigation and small-scale industrial sectors. Groundwater system in mid-hills plays an important role in regulating river flows, maintaining baseflow in particular. Due to various types and scales of human intervention, the spring and seepages at the mountainous areas that were utilized for the drinking purpose have been dried and several villages have been relocated due to lack of water. The principal goal of this study is to analyze and resolve the probable distribution of groundwater occurrence and their spatial association in the mountainous terrain of Jwalamukhi rural municipality, Dhading District.



Location of study area



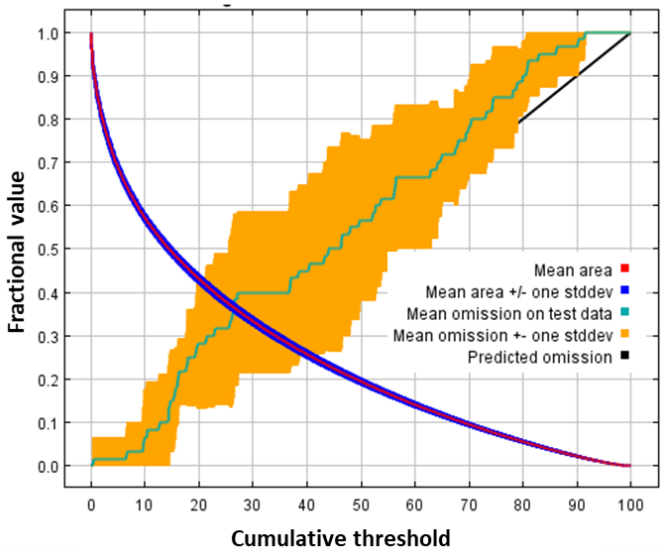
Observed springs

Materials and Method

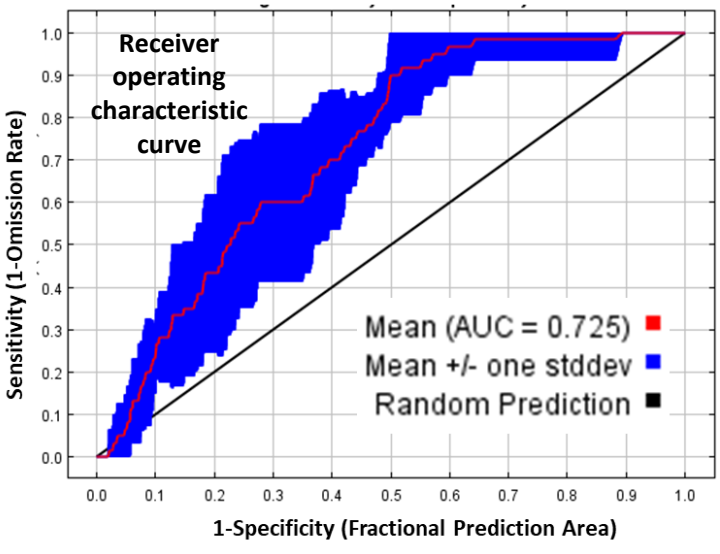
Springs are utilized as a decent pointer of groundwater availability for groundwater potential zoning. During the field visit, altogether, 66 springs were located. Factors influencing the occurrence of groundwater potential zones were identified from previous works (Gintamo, 2015; Rizeei et al.; 2019). The factors which have important role in the identification of groundwater potential includes lineaments, drainage, and topographic indices. Topographic and hydrologic indices (Elevation, Slope, Curvature, drainage density and topographic wetness index) were prepared using 30 m resolution SRTM DEM. Remote sensing is very useful in identifying regional features like lineaments. The lineaments of the study area were extracted from the Sentinel-2 satellite image. The study used presence-only Maxent (Maximum Entropy, version 3.4.1) model (Phillips et al.; 2006) to predict the probable distribution of groundwater in the study area. The maximum number of background points was selected 10,000. Out of 66 occurrence data of spring within the study area, 80% were employed for the training, and 20% were employed as test for the model.

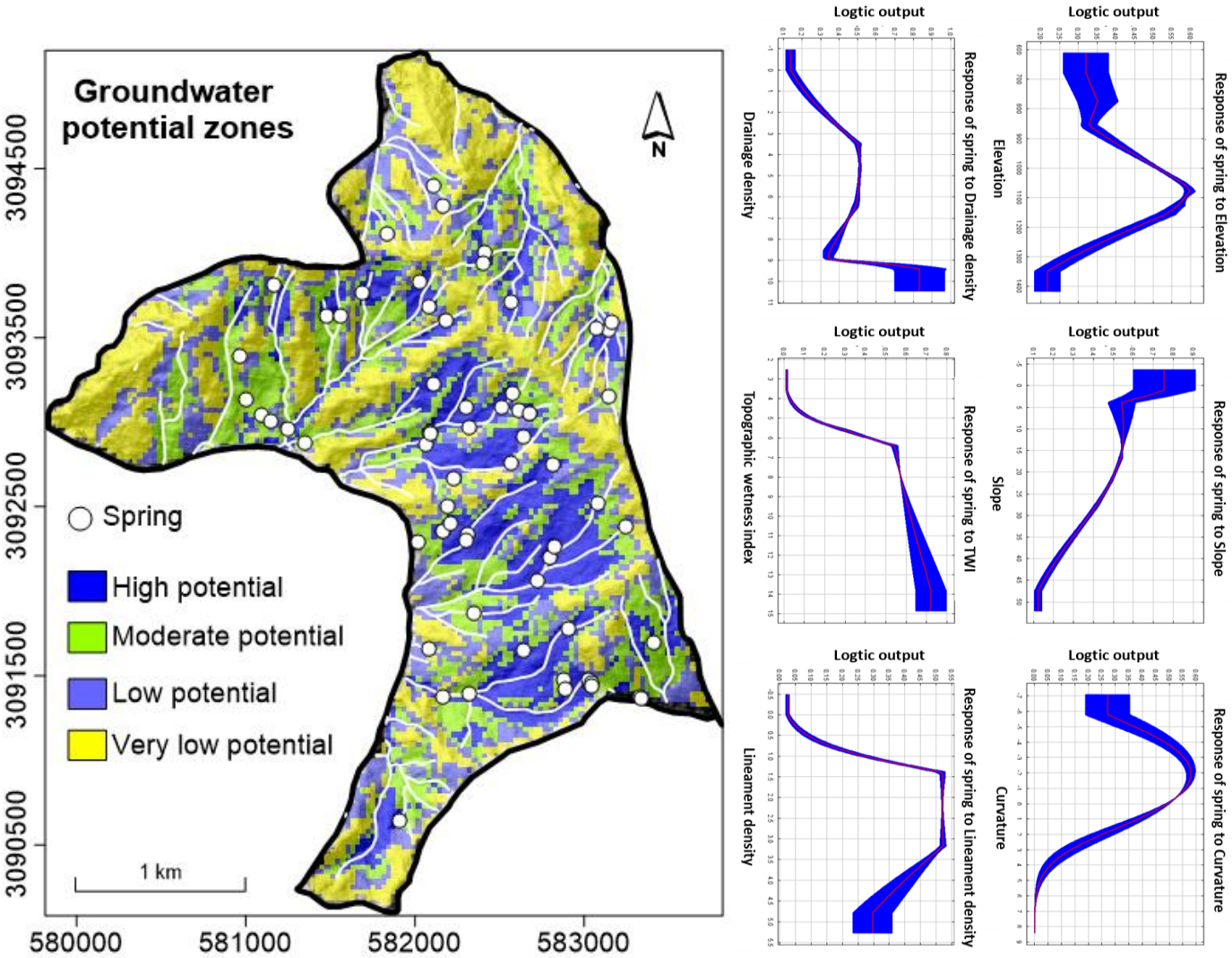
Results

Average Omission and Prediction



Average Sensitivity vs. 1-Specificity





The probability distribution values were reclassified using natural break algorithm namely High, Moderate, Low and Very low groundwater potential zones. The result of the model was validated using area under the curve (AUC) of characteristic receiver operating curve. The distribution of groundwater predicted by the model produced high success rates with a mean training AUC value of 0.725±0.062.

Conclusions

These results demonstrated the capability of presence-only model for the capturing of groundwater potential areas in the mountainous terrain. We can also apply a similar methodological approach in other mountainous terrain with similar geo-environmental conditions to save time and money in predicting groundwater potential zones.

Reference

Gintamo, T.T., 2014. Ground water potential evaluation based on integrated GIS and remote sensing techniques, in Bilate river catchment: South rift valley of Ethiopia. ASRJETS, 85-120.

Phillips et. al., 2006. Maximum entropy modelling of species geographic distributions Ecol. Model., 231-259.

Rizeei et. al.,2019. Groundwater aquifer potential modeling using an ensemble multi-adoptive boosting logistic regression technique. Journal of Hydrology, 579, 124172.

FOR FURTHER INFORMATION:

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