# A GIS-based Soil-Landscape Modeling Approach to Predict Soil Drainage Classes and Depth to Iron and Manganese Concretions

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The relationships between soils and landscapes are seldom studied in conventional soil survey. The objectives of this study are to integrate the spatial analysis of GIS and the properties of soils for describing the relationships between landscape and the depth to iron and manganese concretions, and grey mottles of rural soils in Taoyuan county, northern Taiwan. Soil formation factors including relief, parent materials, vegetation, and hydrology were selected and defined as the quantitative variates of landscapes including elevation, soil parent materials, distance to local stream, distance to local irrigated channel, distance to local irrigated pool, distance to local road, and distance to living area. Two hundred and twelve soil pedons were sampled from 1774 hectares study area. The grid sampling method was used to take the soil samples from soil surface to 150cm depth and the sampling interval in every pedon was 10cm depth. The distance between two sampling pedons are 250 meters. The soils in the studied area can be divided into two groups, one is red earths (Ultisols) and the other is gravel or sandy soils (Entisols). These data were stored in a geographical information system (GIS) and processed with a multivariates discriminant analysis (MDA) to establish the soil-landscpe model based on field sample points and landscape variables and also to generate the soil class map and maximum probability map for predicting the different soil properties in the studied area.

The results indicate that the distribution of the Fe, Mn concretions in studied area were influenced by the distance to local stream and to living area, while the distribution of the depth to grey mottles were influenced by the distance to local living area. The shorter the distance to living area the more the oxic condition will be found in the soil profile, and the deeper to the Fe concretions, Mn concretions, or grey mottles will also be found in the lower part of the pedons. The accuracy of the depth to Fe concretions, Mn concretions, grey mottles, and soil drainage classes predicted by soil-landscape model in all studied area were 67%, 65%, 52%, and 70%, respectively. In gravel or sandy soil area, it reached 89% and 91% of the accuracy to predict the depth to Fe and Mn concretions, compared with only 33% and 35% of the accuracy based on the conventional soil survey approach. The accuracy of soil survey to predict the soil drainage class was about 50% which the errors were attributed to actual poor drainage were regarded as good drainage in soil survey report. The soil class map created by soil-landscape model have 40% agreement in the studied area compared with the soil survey map, and the most area of the disagreement was almost distributed in the area of red earths. The technique based on soil-landscape attributes will be helpful on soil survey in the future, it not only explains the relationship between the landscapes and soil properties and estimates the uncertainly area associated with soil mapping activity, but also updates the soil maps of different properties to be more ease and rapid. The raster geographic information data created in this study also can be shared for another researches in other GIS applications in the nature sciences.