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Digital Mapping of Soil Carbon Storage and Available Water Capacity in Korea

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Abstract

Soil carbon storage and available water capacity are important properties for land management, plant production and environment and ecosystem management. This paper will apply the digital soil mapping concept for mapping these two properties in the South Korea. A Korean soil database was compiled, which includes chemical and physical properties such as particle size, moisture retention, organic matter, cation exchange capacity, and a limited number of bulk density data based on 380 soil series. The first step is to estimate bulk density for estimation of both C storage and available water capacity. Bulk density at different depths of soils was predicted by deriving a pedotransfer function model with sand, depth, and organic matter, based on Adamsąŕ model (1973). Organic C distribution with depth was first derived by converting from mass basis C (kg/kg) to volume basis C (kg/m3). C storage (kg/m2) was first calculated by multiplying C on the volume basis to the thickness of each soil layer(m), and finally integrated to a depth of 1 m for each soil series. Mapping available water capacity was more challenging as only half of the database contains measurement of water retention at -33 and -1500 kPa. Furthermore measurement of water retention is in mass basis and based on disturbed soil samples. Pedotransfer functions were derived for volumetric water content at field capacity (-33 kPa) and wilting point (-1500 kPa). Further adjustments based on total soil porosity are required as the field capacity values were derived from disturbed soil samples. Field capacity was calculated from clay content and predicted bulk density and adjusted by taking into account porosity.

Wilting point was calculated from clay content and adjusted for any discrepancy with predicted field capacity and porosity. Available water capacity (mm) to a depth of 1 m was estimated by multiplying the amount of water stored between field capacity and wilting point and the thickness of the layer. The carbon storage and available water capacity from surface to a depth of 1 m for the south part of whole Korean peninsula were mapped using the estimated parameters in a soil series map unit (1:25 000). Mean value of carbon storage of Korea is approximately 7 kg/m2 and available water capacity is approximately 138 mm. Land use that influences both properties is also considered in this study.

Keywords: Soil information, carbon storage, available water capacity, Korea, digital soil mapping