

Establishment of the minimum data set for cultivated-layer quality assessment and its verification: A case study of sloping farmland in a purple hilly area, China

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Abstract

Sloping farmland is an important cultivated land resource and erosion source. Cultivated-layer quality directly affects the soil productivity and erosion resistance of sloping farmland. We aim to select the most effective soil property index to construct a minimum data set (MDS) and use two methods (the weighted additive cultivated-layer quality index (CLQIW) and Nemoro cultivated-layer quality index (CLQIN)) to accurately evaluate the cultivated-layer quality of sloping farmland in purple hilly areas. The total data set (TDS) of 12 soil indexes was screened by principal component analysis (PCA) and correlation analysis, and a MDS was constructed to assess the CLQIW and CLQIN. The results showed that (1) the cultivated-layer soil quality of the MDS comprises cultivated-layer thickness, soil bulk density, saturated hydraulic conductivity, sand, clay, shear strength and soil organic matter. The MDS can accurately reflect the effective soil information ($RW2=0.7524$, $RN2=0.8059$) and can replace the TDS in cultivated-layer evaluation. (2) CLQIN-MDS has a higher Ef and lower ER than CLQIW-MDS does, so CLQIN-MDS is better for evaluating the cultivated-layer quality of purple soil of sloping farmland. (3) For the two evaluation methods, the quality classifications of the two small watersheds have similar trends, with most plots in grades II~III (approximately 90%). (4) The main obstacles of the two small watersheds are poor nutrients and low soil shear strength, which can be reasonably controlled by subsoiling combined with biochar. These results can facilitate the construction of reasonable cultivated-layers and improvements in the cultivated-layer soil quality of sloping farmland.

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