

Predicting Soil Properties from Landscape Attributes with a Geographic Information System

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ABSTRACT

Soil property maps are often critical layers in geographic information systems (GIS), particularly when used in land management decisions. Unfortunately, the soil maps of the highlands of Northern Thailand are mostly described as slope complexes for which soil characteristics and properties are not available. In this study, landscape attributes (land use types, topographic attributes, and climatic data) derived from remotely-sensed data and GIS technology were used to express our understanding of the distribution of soil materials in the Wat Chan watershed, Chiang Mai province Northern Thailand. Analyses of 107 soil samples in the landscape showed that values of topsoil properties were higher than those in the subsoil except for clay content and exchangeable magnesium (Mg). The variation for topsoil properties was also higher than that in subsoil except the variation in soil Mg. Analysis of the soil landscape indicated that elevation, slope, land use, and annual rainfall were the attributes most highly correlated with measured soil properties. Compound topographic index (CTI), which is an index that refers to a steady state of soil moisture and profile curvature, showed some influence on soil nitrogen (N) and organic matter (OM) in this landscape. Multi-linear regression analysis for predicting soil properties from landscape attributes revealed that sand, silt, N, OM, extractable phosphorus (P), and bulk density variable could be predicted in this landscape as indicated by t-test with R^2 ranging from 0.40 to 0.55.

Key words: Soil properties, Landscape attributes, GIS, CTI

INTRODUCTION

In recent years, a major focus of attention in Thailand for resource managers has been the deforestation processes in the northern highlands. Uncontrolled and unwarranted deforestation is perhaps the greatest of all ecological dangers that can de-stabilize crop production, sustainable productivity and food security. This attention has led to a call for sustainable land resource management for enhanced productivity and performance of land resources, while minimizing any negative effects on the environment. Soil information, one of the important factors for evaluation of sustainable land resource management, could be useful for resource managers in providing a basis for assessment and restoration (Syers, 1995). With accelerated land and environmental degradation of tropical forests caused by deforestation, maps of soil information have become valuable tools for land use planning and natural resource management.