SOIL GEOGRAPHY AND CLASSIFICATION

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Summary

On a world-scale, soil geographical distribution has been the basis of past and current soil classification systems with a global extent. This way, global soil distribution could be presented in a coherent and comprehensible fashion, which is of importance in teaching soils and their relationship to landscape, climate and geology. The concept of zonality, first presented by Dokuchaev in relation to climate, and further developed by Marbut to include other soil-forming factors, has long been the basis for presenting the global soil geographical distribution. Obvious remnants of this concept can still be found back in world soil classifications like Soil Taxonomy, the FAO/UNESCO Soil Map of the World Legend, and the World Reference Base for Soil Resources (WRB).

In this contribution an overview is given of the three main world soil classifications and their link with soil geographical conditions. In addition, some national systems are shortly discussed, and a closing chapter deals with the role of soil geography and soil classification in land use planning and land cover studies.

1. Introduction

Soils are natural, three-dimensional bodies that reflect the impact of climate, vegetation, fauna, Man and topography on the soil's parent material over a variable time span. This

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definition encompasses the various geographical factors that are responsible for the large variety of soils in the world, and embodies the intimate relationship that exists between soil and geography. The term *natural body* might suggest that man-made soils are excluded as many people consider them *non-natural bodies*. Nevertheless, they will be included in the following discussion.

Soil geography deals with the distribution of soils as function of the five recognized soil-forming factors (climate, flora and fauna including Man, relief, parent material, time), either acting singly or in combination. It forms the basis of such concepts as *zonality* (i.e. the regional distribution of soils in zones), first formulated by Dokuchaev on the basis of climate for European Russia, elaborated upon further by Glinka and Sibirchev, who introduced the *zonal*, *intrazonal* and *azonal* soils approach, taking into account other soil-forming factors than climate. These ideas were later popularized in the western world by Marbut (1935), Baldwin, Kellogg and Thorp (1938), and Thorp and Smith (1949). For a long time, various soil classification systems were based on the zonality concept, especially those developed in large countries like Canada, China, Russia and USA.

Soil-forming factors are, in many instances, linked to geographical factors. The large climatic belts around the world with variable but interrelated rainfall, temperature and evapotranspiration patterns govern the water fluxes in soils and, thus, the precipitation or dissolution of minerals. The altitude (or extreme relief) influences temperature, rainfall (which, for example, is different on the windward or leeward sides) and solar radiation, and therefore the chemical and physical weathering rates. The parent material often determines the major relief phenomena by its varying hardness and resistance to weathering and erosion. Vegetation is not only linked to the prevailing climatic conditions, but also to the parent material, the nature and composition of which determines what plant or crop species can grow and, thus, indirectly influence soil development.

Soil-forming factors may also depend on local micro-variations. A prime example is the non-conform small tropical rainforest that exists near the Mosi-oa-Toenja (Victoria) Falls on the Zambia-Zimbabwe border in an otherwise dry sub-humid environment, due to the almost perennial spray of the falls. All these variations and possible combinations explain the large variety of soil types throughout the world.

At national scales, especially in smaller countries, the global soil geographical approach is of less importance to classification as often only one or two of the geographical variables play a role in a country's soil distribution. National soil classifications often exhibit the needs of a country to utilize wisely its natural soil resources, and therefore these classifications take soil characteristics related to soil use into account rather than the soil geography as such.

The purposes of global soil classifications based on soil geographical approaches and those of national systems focusing on soil use are not the same, and the discrepancy between both stems from the confusion between map legends and soil classification systems. Map legends are specifically designed for a map at a particular scale to serve the very purpose of that map. Usually it comprises a logical overview of all the geo-

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referenced polygons occurring on the map. Soil classification on the other hand aims at individual soil profiles (pedons) and therefore is scale-independent. A soil classification system aims at naming any individual soil profile in such a way that a maximum of uniquely defined information is captured in the name.
Map legends can be seen as the executive summary of a soil mapping exercise at a particular scale whereas soil classification is a sorting exercise in which soil profiles are matched to taxonomic units of a soil classification system. Large-scale soil map legends in particular are developed to meet a specific purpose. The outcome in many cases is a soil characteristics map which allows a representation of the soil bodies in terms of soil characteristics which allow for a linkage between the geo-referenced data from maps with models for extrapolation purposes or for process modeling.

The link between map legend, representing the soil geography of a given area, and soil classification, is fostered by the World Reference Base for Soil Resources; the linkage is difficult but very important for facilitating international exchange of geo-referenced soil information and scientific insights.

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Biographical Sketches

Otto Spaargaren has been working for the past thirty years in soil survey and tropical soil management, in worldwide soil correlation and classification, and in teaching at universities and post-graduate courses in the Netherlands and abroad. He spent half his career in Africa and Asia working for consulting companies, development agencies and international organizations, and carried out short missions for the Dutch Ministry of Foreign Affairs, FAO and UNEP. He recently authored several chapters on soil classification in soil science handbooks and published several papers on the World Reference Base for Soil Resources (WRB).

He obtained a PhD in Mathematics and Physics from the University of Amsterdam on an in-depth study of weathering and soil formation on limestone in a Mediterranean environment in Italy. He is currently secretary of the Working Group RB of the International Union of Soil Sciences and moderator of the FAO Forum on Discussion List of WRB.

Jozef Deckers is professor of Soil Geography, Land Evaluation and Tropical Soils at the Faculty of Bio Engineering Sciences of the Catholic University of Leuven. After his PhD in the field of land evaluation for fruit growing, he was fielded for FAO as expert in various soil service projects under the division of Land and Water in Tanzania and Ethiopia from 1980 to 1990.

Since his return at the faculty he developed a research program in soil genesis, soil conservation and land evaluation in sub-Saharan Africa. He served as chair of the IUSS Working Group on soil classification, RB from 1994 till 2002. Since then he is vice-chair of the IUSS Commission 1.4: Soil Classification.

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