new type into the soil family to distinguish artificial soils from natural ones. This proposed scheme for soil classification is believed to be able to reflect effects of human activities varying in type on soil, which fills a gap by a certain degree in the study on classification of this type of soils.
Keywords: Soil taxonomy; Artifacts; China
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(5977 - 2165) Are Geographic Information Systems and Remote Sensing Technologies Enough tools for improving landuse planning? A case study of Arnaha VDC of Saptari District, Nepal

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A detailed soil survey was carried out in Arnaha village area (1000 ha) of Saptari District, Nepal in early 2017 to evaluate and improve rural land uses for micro-level planning and productivity. RS and GIS techniques were used to create the baseline data. DTM was used to delineate the boundaries of land units. These were assigned to different land systems, and boundaries defined ased on position, slope, direction, drainage of landscape features which are especially important for local level project designing. Seven types of land system units (1a to 3c) were identified where 13 pit locations were superimposed and described by excavation of fresh pits in the field. More than one soil pit were enclosed by soil mapping. Thus classifications were made based on soil association. GPS receivers guided the field survey team. At each pit location, soil samples of each horizon and control section were obtained for further laboratory analyses and soil classification made following USDA method. Soil samples were then transferred to recognized laboratories in Kathmandu for analyzing physical and chemical properties using standard methods including texture, organic matter, pH, N, P, and K of soil. Lands were found laying on nearly level landscape (<3 degree slope). The results show that at Order level, there occur only three kinds of soils, i.e., Alfisol, Entisol and Inceptisols which occupy about 1.23%, 2.63% and 93.72% of the total area, respectively. At sub-order level, Udalf, Orthent, Ochrept, Udept and Umbrept are most commonly found soils. At great- group level, a myriads of soils are found mostly falling under Inceptisols. Aberrations were found common while classifying soils at sub-group level. No clear relationships were found between soil profile characteristics, soil fertility status (nutrients level) and crop productivity dynamics of the area. It appears that landuse planing for choosing better agriculture system/practice should also be aided by field level experimentation and in-depth knowledge of other local biophysical factors that control the land productivity.
Keywords: Soil database, micro-level planning, profile description, soil mapping units and land systems
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(7180 - 2387) Brazilian Soil Classification System (SiBCS) reached 20 years - results and advances

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In 1997, a group of scientists led by Embrapa Soils with Universities and research institutions from Brazil presented the first complete document of the Brazilian Soil Classification System (SiBCS), in search of contributions from all pedologists. The first approximation was released in 1978, with new versions in 81 and 88. The first edition of SiBCS was published in 1999, with an Executive Committee that has the goal of validating, and evaluating proposal of new classes. Regional groups contribute to development of the SiBCS, and are supported by Embrapa and Brazilian Soil Science Society (SBCS). A national classification unifies soil data and allows inclusion of classes important to Brazil, in terms of agriculture and their unique environments, such as Pantanal and Caatinga. Another relevant part of SiBCS project is the Reunion of Classification and Correlation of Soils (RCC). The last RCCs visited areas that were not known by many pedologists in Brazil. In 2010, Acre state held a RCC; it was the first correlation in Amazon region. In 2012, it was in Pantanal and Cerrado region of Mato Grosso. In 2015, Roraima was visited for the first time by a large number of soil scientists, with unexpected ecosystems, including soils more related to dry regions of Brazil than Amazon Forest. The most recent, in 2017, crossed Rondônia, visiting ecosystems from Amazon Forest, high altitude grasses and shrub fields, large flood plains, to Cerrado. During the RCCs, specialists in soils examine profiles, previously sampled and characterized, along a route established by the organizing group, to review the classification and to propose new classes or change criteria. The RCCs trains new professionals, and allow exchange of knowledge about soils and environments of regions usually not known by many pedologists; and to local scientists helps to form research networks. The last contribution was to fuel the interest on detailed soil surveys. This supports the national wide program identified as Pronasolos, a response of Embrapa, leader of the project, from a demand of Brazilian government, with collaboration of a large number of Universities, research and extension institutions, and government sectors of Brazil. It became clear to decision makers, at the government level, that to manage and optimize agricultural practices toward sustainability of the agro-ecosystems, and preservation of natural resources, it is essential to know the Brazilian soils in detail.
Keywords: National soil classification; field correlation; Pronassolos
Financial support: Embrapa; SBCS; UFRRJ; IBGE; UDESC

(4508 - 1610) Development of an expert system for classification of Brazilian soil profiles

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The Brazilian Soil Classification System (BSCS) is the official taxonomic system for soil classification in Brazil. With the collaboration of professionals from several research and teaching institutions in the country, BSCS is in its third printed edition. Although it has been published many years ago, there is still no widely available computer program that simulates the decision-making of domain experts for the classification of Brazilian soils. The objective of this work is to build an expert system to assist professionals who need to classify Brazilian soil profiles. Based on the BSCS rules, the system simulates the reasoning of a domain expert when performing the classification of soil profiles. In addition to assisting the work of pedologists, the system can be used as a didactic resource, since it can explain in detail the path that leads to a particular solution. The system is in the prototype phase and has been developed in the Prolog language. It is able to classify soil profiles according to BSCS in different categorical levels, according to the data provided. Tests are being conducted on hundreds of samples already classified by domain experts. The development of this system brings many benefits, to wit: a) it increases the availability of knowledge on soil classification; b) it assists in the dissemination of BSCS, since it is documented not only in the form of publication, but also in software format; c) it is a rule-based system, so its development can be incremental, enabling consistency and performance tests as new knowledge is introduced; d) it has been developed using free software, resulting in reduced costs for its

operation and maintenance, by the research institutions and users interested in its functionalities. Apart from these benefits, this software tool can still be used to validate previously classified profiles, classify new soil profiles and subsidize the evolution of BSCS, since it is an open taxonomic system.
Keywords: soil classification, BSCS, expert system
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(2903 - 1254) Evaluation of a national crop productivity index: revision for Kansas, USA

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For many decades, researchers have created indices to rate soil on its ability to produce vegetative growth. The National Commodity Crop Productivity Index (NCCPI) model provides producers, scientists, and others with an interpretation about the ability of a soil to successfully produce a commodity crop in the United States. The NCCPI uses data from the National Soil Information System (NASIS) to calculate the index for the United States. The index is publicly available on Web Soil Survey under Land Classifications (https://websoilsurvey.sc.egov.usda.gov) and was developed for the purpose of providing an interpretation for the production of commodity crops for rental payments, farm management planning, and when yield data is inconsistent. However, it has been shown that the NCCPI falls short in providing an index at a regional or local spatial scale. Therefore, some states in the USA have developed indices specifically for land within their borders, especially for maize. These indices are often more accurate, relevant, and usable for the client since focus is on a smaller region with less variability in soil type, climate, and management. This study aims at finding the shortcomings of the NCCPI model in order to develop a more detailed, fitting index for maize productivity in Kansas, USA. Observed yield from locations in Kansas will be used to analyze differences between the current NCCPI and an adjusted NCCPI for Kansas. This presentation will provide maps and statistics about these differences in order to draw conclusions about the value of a Kansas-specific crop productivity index. Accurate interpretations provide understanding of the uses and limitations for soil and can be made across the globe if detailed, functional, and precise data for a specific region are available.
Keywords: soil survey, crop productivity, land classification
Financial support:

(9249 - 1273) Modification of Paleustults at Subgroup Level: a Case of Tropical sandstone and siltstone-derived Soils

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Ultisols are the most extensive soils found in Thailand and Paleustults in particular not only distribute vastly in almost all regions but also are very important for field crop production in the country. According to Soil Taxonomy, the great group is provided for use elsewhere, resulting in all Paleustults being categorised in the same subgroup, Typic. This leads to a difficulty in an interpretation for agricultural use and soil management recommendation in spite of most soils in this great group having, to some extent, different morphological, physical and chemical characteristics as shown by soil data of more than 50 soil profiles collected from upland areas where cassava is a major crop. The soils are derived mainly from sandstone and siltstone and formed on different positions of landscapes. The plant grown on these soils shows different response in terms of growth and yield given, indicating that cultivation and soil management including fertilisation practices should be impremented differently in order to obtain reasonable yield and to use the soils sustainably. To provide some subgroups for use with these Paleustults is likely to be useful in the context of making soil management guidance and for technology transfer purpose. Several subgroups, namely Aquic, Oxyaquic, Ombroaquic, Plinthic, Arenic, Grossarenic, Psammentic, Udic, Kahaplic and Rhodic, can be used with these Paleustults and make them to have better interpretability of which a precision agriculture basing on the interpretation of these newly provided subgroups of the Paleustults can be done more practically.
Keywords: Soil Taxonomy, Soil Interpretibility, Tropical Soil, Upland Ultisols
Financial support: Kasetsart University

(8989 - 853) Object of natural soil classification: Is it a system or an element of a system?

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As it is known, any natural classification is unthinkable without a precise definition of its object. Revealing the essential character of the object, such definition determines differentiating criteria, structure and, on the whole, the scientificity of the classification system. There are many soil definitions, but in spite of this, attempts to give a new soil definition continue. This proves the importance and complexity of the problem. It is suggested to get back to basics, namely, to a soil definition given by V.V. Dokuchaev, however, improved basing on the General Systems Theory approach, which means studying objects as systems and/or as elements of systems. The following soil definition is offered: Soil is a material self-sufficient system and, at the same time, a derived element of a higher order system that is a natural landscape. Soil is a unique landscape element because only it originates from interaction and interrelation of the other (basic) landscape elements - rocks (parent material including peat and buried soils), air, water, and organisms. The definition reveals the essential character of soil (which is its systematic nature) and is taken as a basis for the development of a hierarchical Natural Soil-Landscape Classification System, which objects are both natural landscapes (as systems) and soils (primarily as derived elements of natural landscapes). In the classification system, differentiating criteria are strictly distinguished from diagnostic ones. As distinct from differentiating criteria, the latter are formal (external) and, on a large scale, morphological properties of natural soils and landscapes. At the higher levels of classification, differentiating criteria are essential (internal) properties of natural landscapes (for example, stability/instability of landscape vertical structure), and at the lower levels - essential properties of basic landscape elements directly responsible for essential properties of soils (for example, type of megarelief). Successive division of natural landscapes causes successive division of soils associated with these landscapes. Selection and ranking of the differentiating criteria are conformed to the rules. The classification system combines soil and landscape classification systems, integrates genetic approach with morphological one and thus differs essentially from current soil classification systems, which consider soils primarily as self-sufficient systems composed of genetic horizons.
Keywords: Soil definition; the General Systems Theory approach; soil-landscape classification; soil-landscape associations; genetic approach.
Financial support:

(7523 - 1496) Preliminary Thoughts About a New HAHT Soil Order for Soil Taxonomy

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