Correlation and Evaluation of Applicability of Soil Classification Data According to World References Base for Soil Resources (WRB): The Comparative Study of Farah Province, Afghanistan

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Abstract

In 2009 a USDA surveyor and expert team provided the technical expertise for, collecting, securing, shipping describing, and classifying soil samples to the National Laboratory of USDA, Lincoln Nebraska. 8 soil pedons have been sampled from Farah provinces. The US scientists addressed the soil fertility issue by investigating soil samples taken from the top three horizons (depth averaging 50 to 80 cm). Accordingly, soil samples were collected for laboratory analysis and classified according to US Soil Taxonomy. This study has been conducted on the classification of Farah soils according to WRB soil classification system. The aim of the study was to provide correlation possibilities of the available Afghan soil data with the international soil classification system of the World Reference Base for Soil Resources (WRB), based on simplified correlation rules, the classification has been done based on available and details of soil survey data of the USDA NRCS Taxonomy.The achieved results are 6 soil types, which five profiles (Calcisols) and three profiles (Solonetz) in Farah Province Afghanistan. In the correlation both systems have some similarities, in giving information on texture properties, calcium carbonate contents, saturation with ground/ surface water, and some few more aspects of soil characteristics.

Keywords: *Soil classification, soil properties, Soil Taxonomy, Diagnostic Horizon, WRB, Qualifier.*

I. INTRODUTION

The study has beenconducted on soil classification of Farah Provinceaccording to The World Reference Base for soil resources (WRB) soil classification system. The classification has been done based on the available laboratory soil data, profile description and classification information in the soil taxonomy used for correlation and classification. The data has been collected by the United States Department of Agriculture (USDA) experts of soil taxonomy from 8soil profiles in Farah province of Afghanistan(Tallyn. E.etal.2009). In the soil classification according to the WRB soil classification system, characterizing Soil properties in terms of diagnostic horizons, properties materials is very important, the selection of diagnostic characteristics takes into account their relationship with soil forming processes. It has been recognized that an understanding of soil forming processes contributes to a better characterization of soils. The climatic parameters are not used in the classification of WRB system. It is fully understood that it can be used for interpretation purposes, in dynamic combination with soil properties (WRB, 2014).

A. OBJECTIVES

1. To provide correlation possibilities of the available Afghan soil data with the international soil correlation system of the World Reference Base for Soil Resources(WRB) based on simplified correlation rules.
2. To characterize and classify the soils of Farah province according to the WRB based on the detailed soil survey data of the USDA and NRCS.
3. To evaluate the differences between the information content in terms of applicability in land use and planning, provided by the USDA Soil Taxonomy and the WRB classification system, to make conclusions for future soil inventory and mapping activities for Afghanistan

II. METHODOLOGY

A. Study area: Farah Province

Farah province is located in western Afghanistan and belongs to Farah's Road River basin. Situated between 31.39-33.51 degrees latitude and 60.58-64.75 degrees longitude, the Province is bordered by Helmand in the East, Nimroz in the South, Ghor in the Northeast, Herat in the North, and Iran in the West (MRRD, 2007). The climate is arid since the annual rainfall is between 90 – 120 mm, there are 549 villages and an estimated population of 726,170, Farah province has divided into 12 districts (USAID, 2008).

B. Correlation Methods

For the correlation of the different soil classification systems with the WRB system, thediagnostics (Horizons, materials, and properties) and qualifiers that are relevant between the environmental conditions of Afghanistan were selected based on the available soil data and expert judgment. When sufficient data was available, simplified correlation rules were applied based on the definitions in the WRB, and the available soil data. The simplified correlation rules are described in details in the (table2).

III. RESULT AND DISCUSSION

In the WRB soil classification system is needed to check the thickness and depth of the layers for requirements of WRB diagnostic (horizons, properties, and materials) which are related to morphological and analytical criteria. The combination of diagnostic horizons, properties and materials is compared with WRB keys in order to find the RSGs, and the qualifiers which are prefixes and suffixesand are used to identify the specific materials and properties in the soils, the specifiers are also used to indicate the degree of expression of qualifiers (WRB, 2014).The diagnostics horizons, properties and materials of 8soil profiles of Farah have been describedand characterized. the soils of the area are classified according to WRB.To achieve this result it is very important to go strictly through the key of WRB soil classification system

Table 1:The full profile results according to (WRB) soil classification System (2014)

Pedon ID	Latitude	Longtitude	WRB RSGs	Qualifiers/Prefixes	Qualifiers/suffixes
S09AF006001	32° 22' 59.00	62° 9' 45.00	1. Calcisols	Hypercalcic	(Hyposodic, Aridic, Novic) (Thapto-Luvisolic)
S09AF006002	32° 23' 10.00	62° 10' 11.00	2. Calcisols	Luvic Hypercalcic	(Aridic, Skeletic, Arenic) (Thapto-Lixisolic)
S09AF006003	32° 25' 36.00	62° 9' 48.00	3. Calcisols	Thaptoluvic	(Endoruptic, Hyposodic, Aridic,Bathyskeletic,Siltic,Novi)
S09AF006004	32° 22' 39.00	62° 12' 51.00	4. Calcisols	Luvic	(Hyposodic, Aridic, Siltic)
S09AF006005	32° 23' 1.00	62° 6' 24.00	5. Calcisols	EndostagnicLuvic	(Hyposodic, Aridic, Clayic)
S09AF006006	32° 21' 12.00	62° 3' 48.00	6. Solonetz	Calcic	(Aridic, Siltic, Novic)
S09AF006007	32° 22' 52.00	61° 56' 53.00	7. Solonetz	Calcic Stagnic Salic	(Aridic, Siltic, Novic)
S09AF006008	32° 17' 29.00	61° 45' 55.00	8. Solonetz	Calcic	(Colluvic, Aridic, Endoskeletic)

Table 2: Indicate the correlation of (ST) and (WRB)soil classification system (2014, 2011)

ST Classification	WRB RSGs	Qualifiers/Prefixes	Qualifiers/suffixes
1. Sandy, carbonatic, hyperthermic Typic Haplocambids	1. Calcisols	Hypercalcic	(Hyposodic, Aridic, Novic) (Thapto-Luvisolic)
2. Loamy-skeletal, carbonatic, hyperthermic Typic Haplargids	2. Calcisols	Luvic Hypercalcic	(Aridic, Skeletic, Arenic) (Thapto-Lixisolic)
3.Coarse-loamy, mixed, active, hyperthermic Typic Haplocambids	3. Calcisols	Thaptoluvic	(Endoruptic, Hyposodic, Aridic,Bathyskeletic,Siltic,Novic)
4. Fine-loamy, mixed, subactive, hyperthermic Typic Calciargids	4. Calcisols	Luvic	(Hyposodic, Aridic, Siltic)
5. Fine, mixed, semiactive, hyperthermic Fluventic Aquicambids	5. Calcisols	EndostagnicLuvic	(Hyposodic, Aridic, Clayic)
6. Fine-loamy, mixed, semiactive,	6. Solonetz	Calcic	(Aridic, Siltic, Novic)

hyperthermic Sodic Haplocambids			
7. Coarse-loamy, mixed, active, hyperthermic Aquic Haplocalcids	7. Solonetz	Calcic Stagnic Salic	(Aridic, Siltic, Novic)
8. Fine-loamy, mixed, semiactive, hyperthermic Typic Calciargids	8. Solonetz	Calcic	(Colluvic, Aridic, Endoskeletic)

(Table2) represents results of two soil classification systems (WRB and ST).(Table 1)shows the full resultsof the soil type study. findings indicated that 6 soil type are classifiedfrom 8 soil profiles,which five profile are (Calcisols) and three profiles are (Solonetz) in Farah Province, Furthermore, the specific and dominant properties of all horizons in all profiles are described based on WRBsoil classification system, through diagnostics qualifiers

(prefixes and suffixes) the depths and amount of horizons, materials, and properties which were placed in the profiles have shown by specifiers e.g. (Endo, Hyper, Thapto, Bathy and Hypo),in fact the whole soil profiles had contained high base saturation (100 percent) and high Ph. (alkalinity), the correlation between ST and WRB soil classification systemsare simplified,and indicated that the WRB soil classification systemprovided significantinformation on Base saturation (BS), Cation Exchange Capacity (CEC), Sodium (Na) and calcium carbonates ($CaCO_3$), these are the most important Issues for land use planning,furthermore, Na affects soil quality such as affecting water holding capacity, limiting plant rooting, causes soil compaction problems. BS and CEC are very important for soil productivity. The information content of the two classificationresults will be evaluatedand compared in terms of applicability in land use and planning. I would like to discuss that, both systems have some similarities, in giving information on texture properties, calcium carbonate contents, saturation with ground/ surface water, and some few more aspects of soil characteristics. Hence, basedon whole result information of both classification systems in land use and planning purpose for agriculture, the WRB classification system provided more information than ST classification system which concluded above. In addition, ST classification system mainly focused on climatic conditions, while obviously clear that Afghanistan is located in the arid and semi-arid region, therefore this information does not present a significant understanding about soils based on land use and planning for agriculture in Afghanistan.

Figure 1: Indicates correlation example of ST(USDA, NRCS Revised May 2011, Afghanistan).

1. Correlation example of Soil Taxonomy

ID S09AF006001

Diagnostic Features:

ochric epipedon 0 to 53 cm.

cambic horizon 15 to 53 cm.

argillic horizon 112 to 200 cm.

Strongly contrasting particle size class 53 cm.

lithologic discontinuity 112 cm.

Strongly contrasting particle size class 112 cm.

Secondary carbonates 112 to 200 cm.

Sandy, carbonatic, hyperthermic Typic Haplocambids

Figure 2: Indicates correlation example of WRB(USDA, NRCS Revised May 2011, Afghanistan)

2. *Correlation example of World Reference Base for Soil Resources (WRB)*

ID S09AF006001

Diagnostic Features:

Calcic horizon: 0 to 200 cm CaCO3

Argic horizon: 112 to 200 cm with clay films

Cambic horizon: 15 to 53 cm has a texture of fine sandy loam, platy structure.

Lithologic discontinuity: 53 cm and 112 cm

Aridic properties: 0 to 31 cm evidence of wind erosion

Hypercalcic Calcisols (Hyposodic, Aridic, Novic)

(Thapto-Luvisolic)

C.CorrelationResult

Findings indicated that, WRB gives priority to the presence of high CaCO3 content in highest and second level, andThe Presence of exchangeable Na indicated with a suffix qualifier (Hyposodic),new material is indicated with a suffix qualifier (Novic), and Buried Luvisols is indicated with a suffix qualifier (Thapto-Luvisolic.).

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CONCLUSION AND RECOMMENDATIONS

The study was set out to characterize and classify soils of Farah province according to World Reference Base for Soil Resources (WRB). The soils of this area was characterized and surveyed by two agriculture advisers of USDA with partnership of NSSC at Lincoln Nebraska in 2009, Therefore, based on the detailed soil survey data of the USDA NRCS,the soil of the targetedarea are classified with WRB soil classification system. The objective of the study was to find out the significant difference of two international soil classification systems to find out which system gives more information based on land use characteristics for agriculture in Afghanistan. In WRB soil classification system the diagnostic horizons, properties, and material have been

profiles were (*Solonetz*) soil types in Farah province, the dominant characteristics for each RSGs indicated by qualifiers (suffixes and prefixes) and the amount, depth and position of the horizon, properties and materials has shown with specifiers such as (*Hyper, Hypo, Endo, Epi and Bathy).* I recommend for WRB soil classification system committee to add some more qualifiers for some RSGs to described the whole soil properties, such as in this study I have found out that in *(Solonetz*) soil type, can be find rock fragments it should indicate by (*skeletic qualifier)* and for (*Calcisols)* (Stagnic qualifiers) should be added.The diagnostic approach helps the interpretation and also gives good chance to correlate soil data between classification systems. For future soil data collection for Afghanistan it is very important that systematic survey and data recording should be planned. All diagnostic elements should be determined. Soil classes are important, however according to my study for agriculture planning, and other land use and planning purposes the thematic information (carried in the diagnostic elements) are essential parts of future data bases.

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