Procedures used to develop 1:1,000,000 Soil Map and Densified Soil Map of Afghanistan *and* Procedures used to assign soil taxonomy and soil properties for use as input into the PHYGROW Model.

The primary source of the 1:1,000,000,000 scale soil map of Afghanistan came from a version of the United States Department of Agriculture-Soil Conservation Service (USDA-SCS) 1:1,000,000,000 World Soil Map Series produced in the 1950s and 1960s, and subsequently modified in the 1970s and 1980s. Here, we provide a brief history of the creation and modification of the World Soils Map Series. We then follow with modifications made specific to the Afghanistan PEACE Project needs.

History

The USDA-SCS Soil Geography Staff compiled the first 1:1,000,000,000 World Soil Map Series for the Department of Defense (DOD) at its offices in Hyattsville Maryland, during the late 1950s and early 1960s. The staff at that time consisted mainly of highly trained soil scientists but also included a climatologist and a soil geographer. The resulting maps were a series of schematic maps made from the best information available in the form of maps, aerial photographs, geology maps, climate data, existing soils maps, notes of travelers, and knowledge of the five factors of soil formation. Schematic soils maps are made without access to the area and based on definitions derived from the most current Soil Survey Manual. (1)

The original 1:1,000,000,000 scale maps were named at the Great Soil Group level of the soil classification system described in the 1938, USDA, Yearbook of Agriculture, as amended in 1949. There were usually two or three Great Groups listed for each mapping unit. Furthermore, each mapping unit contained detailed information on the climate, vegetation, agriculture, geology, texture and other soil characteristics of the mapping unit, with the dominant land use of the soils given in the narrative. The purpose of the project was to provide highly generalized soil information for regional planning purposes only. The only drawbacks to these maps was that soil interpretations were very specific to a particular project and to date, little has been published on how to interpret schematic maps.

In the 1970s and 1980s, parts of the 1:1,000,000,000 World Soil Maps were updated by the Agriculture and Resources Inventory Surveys through Aerospace Remote Sensing (AgRISTARS) program to include the latest version of the 7th Approximation of Soil Taxonomy. (2, 3) At times, this effort involved the redrawing of soil mapping units to better approximate the probable extent of each unit. Detailed soil properties data are currently available in a database only at the soil series level. Access to this data is acquired by assigning a typical soil series to each classification unit.

Starting in the year 2000, scientists at Texas AgriLife-Blackland Research and Experiment Center (BREC) in Temple, Texas undertook a project, on behalf of the United States Department of Defense /National Intelligence Mapping Agency (NIMA), to digitize all of the available 1:1,000,000,000 scale schematic soil maps for the purposes of: 1) creating digital copies of the maps, 2) capturing the narratives and AgRISTARS

information into a digital database and, 3) reregistering the maps to TM satellite data as a base map. Additionally, soil classifications were updated for large parts of the world to the latest Soil Taxonomy, at the Great Group or Subgroup level; and Soil Family characteristics were also added to this classification as time and information permitted. (4) The 1975 Soil Taxonomy was adopted as the standard as most of the soil property information was stored in databases under the 1975 classification. (5)

PEACE Project / PHYGROW Model Applications

Two maps for Afghanistan resulted from the digitized mapping effort undertaken by the Texas AgriLife BREC project: one based on the original mapping effort of the USDA-SCS, using the 1949 Soil Classification and the other based on AgRISTARS 7th Approximation Soil Classification and redrawing of the soil classification unit boundaries. These maps in combination with a newer geology map, WMO long term Monthly Average Climate data and TM satellite data, were used to assist in the review, refinement and classification of the 7th Approximation Soil Classifications to the latest Soil Taxonomy, with reference to the 1975 system, for the PEACE Project.

The digitized AgRISTARS 1:1,000,000,000 schematic soil map of Afghanistan was chosen as the starting base soil map for Afghanistan. Following, the soil classification was brought up to the 1975 Soil Taxonomy, at the Subgroup level, with the Soil Family characteristics added. Additional resources were: a newer geology map, (6) better climatic data from FAO and WMO, and satellite imagery. A soil series was then selected that best fit the available information. The database could then be used for soil interpretation. It was decided not to attempt a change in the soil delineation boundaries from the 7th Approximation polygons. Following the lead of the AgRISTARS project, where a soil series was selected that best fit the available information, all soil series were reviewed and some polygons were assigned new representative soil series. Once the representative soil series was assigned for each polygon, soil property data was extracted from NRCS STATSGO soil database into an accompanying database that contained the soil attribute data of interest to the PEACE Project. (7) From this was created the Soil Map of Afghanistan that includes Soil Taxonomy for the whole of Afghanistan (http://jasper.brc.tamus.edu/afghanistan/default.aspx).

Landscape Position Map Layer

We further refined the Soil Map for Afghanistan by assigning three representative soils for each polygon based on landscape position found within a polygon. The procedure used for identifying additional soils in each polygon followed those used by the USDA-NRCS when developing national maps for the United States STATSGO maps. The polygons, also referred to as map units (MUs), in these maps identify soils that are associated with each other on the surrounding landscape. The MUs were developed to show associated soils within a geographic area. In general, MUs are quite large as the map was developed at a scale of 1:250,000. Therefore, soils are found that represent different landscape positions within a soil polygon. A single US map unit was chosen that represented the climate, temperature, elevation regimes of the Afghanistan map unit. From the soils found in this map unit, three series were chosen to represent the lower,

mid and upper landscape positions for each Afghanistan map symbol. This was done by choosing a soil with a low percent slope to represent the lower position; choosing a soil with a moderate percent slope to represent the mid landscape position; and choosing a soil with a high percent slope to represent the upper landscape position. In some cases, a series is assigned to more than one landscape position.

We used ArcGIS to create a raster map of landscape position using 90 m elevation data and GIS proprietary algorithms to assign each pixel in relation to its position between the stream/valley bottom and ridge top found in the local area around the point. These points were then grouped into the three landscape positions represented by the raster map. Soils at the landscape position level can be viewed at http://jasper.brc.tamus.edu/afghanistan/default.aspx.

References:

(1) Soil Survey Manual, 1993. USDA Handbook No. 18:58 for definition of schematic map.
(2) The AgRISTARS program was a joint effort by National Aeronautics and Space Association (NASA), National Oceanographic and Atmospheric Association (NOAA), and the United States Department of Agriculture (USDA) to use satellite technology to monitor grain production for primary grain producing areas of the world.
(3) Soil Classification, 1960. A comprehensive system, 7th Approximation, Soil Survey Staff, Soil Conservation Service, USDA. Aug. 1960.
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(6) Geology and Natural Resources Map of Afghanistan, 2006. Compiled by Jeff L. Doebrich and Ronald R. Wahl. USGS, Reston, Denver, Menlo Park, Tucson and the Afghanistan Geological Survey, Kabul. Version 2. Scale 1:850,000. USGS open file report 2006-1038.
(7) State Soil Geographic Data Base (STATSGO), 1993. Soil Conservation Service, Data Base Users Guide. USDA Misc. Publ. No. 1492.

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