GEOGRAPHICAL APPROACHES TO 7TH APPROXIMATION SUBGROUP ANALYSIS OF SELECTED SOIL INTERPRETATION MAPS

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ABSTRACT. — The potential value of the United States' new soil classification system, the 7th Approximation, is investigated with respect to its applicability in soil limitation problems. Soil limitation studies for the construction of small buildings are made by utilizing detailed soil data and more general soil data organized within the framework of the 7th Approximation subgroup. The results of the research show that 7th Approximation soil limitation analysis can provide a versatile and easy method of developing land use studies without unduly sacrificing the accuracy attained by utilizing detailed soil data.

The theoretical framework of the 7th Approximation (Soil Survey Staff, 1960) is presented in a form that permits the development of maps and the testing of the applicability of the new soil classification system to soil-oriented problems. Research is needed to explore the potential applications of the 7th Approximation beyond its known and theoretical value.

A modified generalized 7th Approximation soil map (Klink, 1967, p. 109) of a county in east-central Illinois is constructed in an effort to ascertain the value of 7th Approximation subgroups in developing a soil use interpretation map for the construction of cottages and utility buildings. A comparison between the results obtained from a detailed soil analysis using soil type-slope-erosion data and the more general 7th Approximation subgroups is made in order to validate or invalidate the 7th Approximation application. Selected geographical interrelationships between the subgroup soil regions and the soil interpretation map for the construction of cottages and utility buildings are analyzed.

The United States Soil Conservation Service has developed over 70 different interpretations of soil suitability or limitation for various land use purposes (Soil Conservation Service Staff, 1966). Soil productivity and drainage characteristic maps are the most common in use; however, the relationships between soil and recreation, surface transportation, construction, industrial location, constructional materials, etc. are becoming increasingly important to many groups of researchers. Planners, soil scientists, engineers, geographers, rural developers, and recreational experts all need and contribute to an understanding of the interrelationships between characteristics of the soil and phenomena related to its best use within a given set of condi-

tions. Only through an understanding of these interrelationships can a proper utilization of land be achieved. Many unicriterial soil interpretation maps judge soil limitation as (1) slight or no limitation (2) moderate limitation (3) severe limitation with respect to the land use under study. In the construction of a limitation map a soil series can be subdivided into textural and then slope-erosion classes in order to obtain a very detailed study unit. Each detailed study unit has a slight, moderate or severe limitation with respect to the phenomena under study. For example in a soil interpretation map for the construction of cottages and utility buildings (with septic tank) each soil type with a different slope-erosion class is ranked severe, moderate or slight limitation for its suitability in this type of construction (Soil Conservation Service Staff, 1966). The soil factors considered in judging soil suitability in the construction of cottages and utility buildings are wetness, permeability, texture, flood hazard, slope, rockiness-stoniness and depth to bedrock. All the available detailed soil data are converted into the proper limitation class and a composite map is made for the desired area. The resulting regions on the map show (1) areas with the greatest suitability for construction of cottages and utility buildings, (2) areas where precautions must be taken before commencement of construction, (3) areas where it is unwise to construct the buildings.

The development of a limitation map based on detailed soil information is time consuming. The accuracy of soil data is excellent; however, conversion of the data to fit general planning needs over a wide range of conditions gives a subjective accuracy to the map. Undoubtedly, the severe, moderate, and slight limitation regions on the resulting map are accurate within the framework of the study since they are derived from very detailed soil series slope-erosion data. It seems feasible to use higher levels of soil classification in order to develop broadly defined soil limitation regions of selected phenomena. A more general soil data source, if properly organized for a particular study, may serve in drawing useable soil interpretation maps which approach in accuracy similar maps based on highly detailed studies. In many studies, development of a map derived from higher levels of soil classification ultimately makes possible a more rapid use and interpretation of many land use features without sacrificing the required degree of accuracy. A 7th Approximation subgroup limitation map of a county can be constructed in a fraction of the time required in the construction of a soil type limitation map provided the subgroup map and average limitation values for subgroups are available. Thus a substantial saving of time is possible if the 7th Approximation limitation studies provide the accuracy demanded in its use.

Subgroups are subdivisions of great groups which are defined largely by the presence or absence of diagnostic horizons and the arrangement of the horizons. Common differentiae of diagnostic horizons include illuviation of clay, iron and humus; thick, dark-colored surface horizons; pans that interfere with root development, water movement or both; and hori-

zons formed under cultivation. (Soil Survey Staff, 1960, p. 14)

The soil properties considered in the determination of the degree of limitation for the construction of cottages are not the specific soil properties used to define subgroups. It is not an objective of this paper to prove that the defined properties of the subgroups determine or explain the properties considered significant in soil limitation for the construction of cottages. Undoubtedly the defined subgroup soil properties reflect characteristics not specifically stated in a subgroup definition. It is the soil scientist that can best analyze the kind and degree of relationship that exists between the defined properties of subgroups and other soil properties within subgroups. An objective of the paper is to determine if a suborder map can present soil patterns that are of value to a geographer in the interpretation of a land limitation study.

If a subgroup map proves to be of value in predicting a soil limitation for cottage construction, then the reasons for the apparent success should be analyzed by the soil scientist, not the geographer, in order to determine whether there is a theoretical basis which will enable expanded use of the subgroup in selected land use studies.

The paper asks the question: Can a geographer or planner use a subgroup map for any planning purpose? The answer to this question cannot always be theoretically determined from subgroup soil property definitions; therefore, an application of a subgroup map may shed light on the possibility of its use in selected aspects of land use study.

Procedure

A 1964 7th Approximation subgroup map of soil distribution in Coles County, Illinois is constructed (see Figure 1) using Conservation Needs Inventory 2% sample data (Conservation Needs Inventory, 1957). Each major soil subgroup in Coles County, Illinois has its degree of limitation with respect to cottage and utility buildings with septic tank calculated. The group of soils that in total comprise a subgroup of the 7th Approximation in Coles County are analyzed and an average limitation value is calculated. Table 1 shows the values assigned to the degree of limitation in this study.

If a 7th Approximation subgroup has combined soils of very similar reaction with respect to the phenomena under study then the differential distributional character of the soils within the subgroup is of little significance. If, on the other hand, the subgroup combines soils of widely varying reaction with respect to the phenomena under study, then use of the 7th Approximation subgroup will yield results that are subject to great error.

Subgroup limitation values used in conjunction with a version of Figure 1 results in a soil interpretation map, Figure 2, which is a prediction of the degree of limitation in the construction of cottages and utility buildings. It might be noted from Figure 2 that no part of Coles County is free from moderate to severe limitations with respect to use for construction cottages and utility buildings since all areas (when generalized) fall into categories 3 to 5. Closer scrutiny, however, reveals that a large portion of the county suffers from only moderate limitation, there being only restricted areas in categories above 4. Limitations under 3 are found in the study area but do not appear in a generalized map as shown in Figure 2. Figure 2 is generalized for purposes of clarity but a more detailed version can be prepared for actual land use planning if the map is proved accurate for its required use.

The degree of accuracy of Figure 2 is ascertained through the construction and analysis of a map (Figure 3) which compares the 7th Approximation subgroup limitation map with one based on the most detailed soil information available (soil type-slope-erosion classes). The comparative study uses the same 2% sample data but the organization is

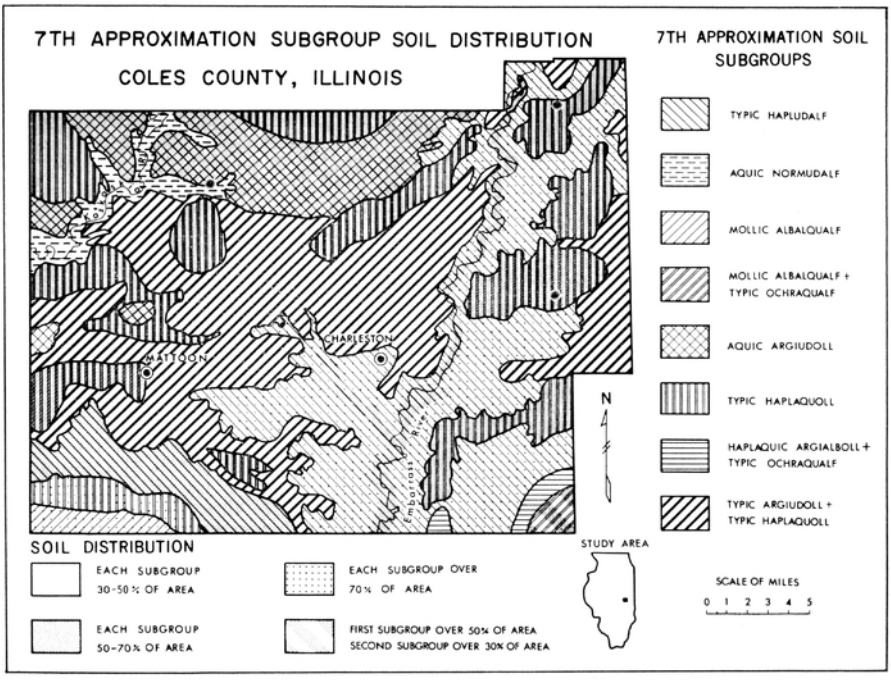

FIGURE 1. — 7th Approximation Subgroup Soil Distribution, Coles County, Illinois.

TABLE 1.—Numerical Values Assigned to the Degree of Soil Limitation in the Construction of Cottages and Utility Buildings.

Degree of Limitation	Numerical Value
Very Severe	5
Severe	4
Moderate	3
Slight	2
Very Slight	1

within a very detailed level of the soil classification framework. Figure 3 shows the extent to which limitation units (Figure 2) deviate (+ or —) from the results obtained from the most accurate expression of limitation which is based on very detailed soil data.

DISCUSSION

In general, the deviations between the detailed soil analysis and the more general subgroup analysis are small. In Figure 2 approximately 15% of the study area has results that are essentially identical (.00-.10 deviation) with the results obtained from a very detailed soil analysis. Another 20% of the study area has a deviation that is so small (.10-.25) that it cannot alter any conclusion in a practical application of a general soil interpretation study. Over 50% of the study area has a more noticeable variation (.25-.50), but again this range of deviation would not alter general land use planning decisions made from Figure 2. In less than 10% of the study area does the deviation exceed .50. The actual maximum calculated .62. Some consideration of error must be taken in these areas but even a .60 deviation

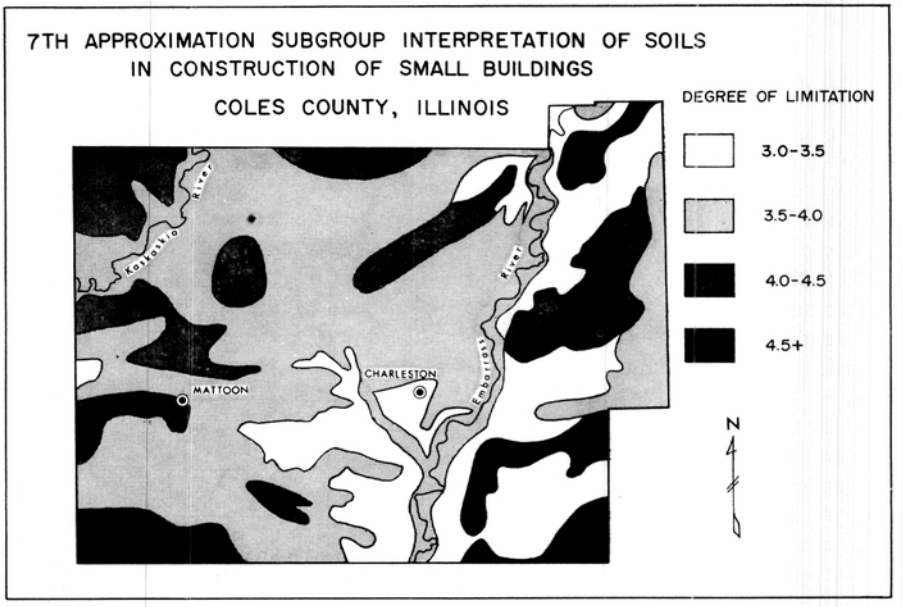

FIGURE 2. — 7th Approximation Subgroup Interpretation of Soils in the Construction of Small Buildings, Coles County, Illinois.

does not change the essential character of limitations required in the relatively "higher" error area. For example, a predicted limitation value of 3.10 northwest of Mattoon is calculated at 3.70, seemingly a large deviation. Yet the error is not excessive when considered within a subjective framework suitable as a broad guide for planning. The other deviations between .00-.50 have little or no change in most subjective definitions. Thus, in the study, a limitation map utilizing 7th Approximation subgroup data is subject to varying degrees of error when compared to a limitation map derived from very detailed soil data. However, the difference between the two maps is small and for general planning purposes the subgroup-based map can be used effectively.

GEOGRAPHICAL INTERPRETATION-SUBGROUP LIMITATION MAP

The study provides a general map for planners and shows in one case that the subgroup level of the 7th Approximation groups soil of such similar character that it can effectively be used in a limitation study. However, the study also provides materials which when analyzed give insight into the interrelationships between the character of the soil and, in this case, its use for constructional purposes. Analysis of the limitation regions and soils which comprise the subgroups within the regions provide the geographer with interpretative information. In Figure 2 the regions with limitations between 3.00 and 3.50 have close association with well-

drained soils, moderate slope and lack of excessively heavy subsoil. Locally severe limitation areas within the region correlate with extreme flatness, excessive slope, excessive erodibility and poor drainage. Soils that were formerly named Gray-Brown Podzolic or well-drained Brunizems areally dominate in the area. Parts of the Shelbyville Moraine and dissected Embarras River Valley area have the best soil character for the construction of cottages and utility buildings.

Limitation areas between 3.50-4.00 are dominated by gently rolling topography, moraine or parts of river valleys. A greater percentage of the soils are ill-drained (as in the swales of the prairie area of flood-plains) compared to the 3.00-3.50 region. Gray-Brown Podzolic soils remain important. The general associations made in region 3.00-3.50 apply in this limitation region also but a noticeable shift to greater roughness or poorer drainage is evident resulting in more severe limitations for the construction of cottages.

Limitation regions 4.00-4.50 have distinctly different associations from the previously discussed regions. Limitations are severe. The soils in this region are ill-drained types with fine-textured soils becoming somewhat dominant. Topographically, areas dominated by swales or other flat features are the most common in this region. Humic Gley soils, Planosol-like soils and some Alluvi-

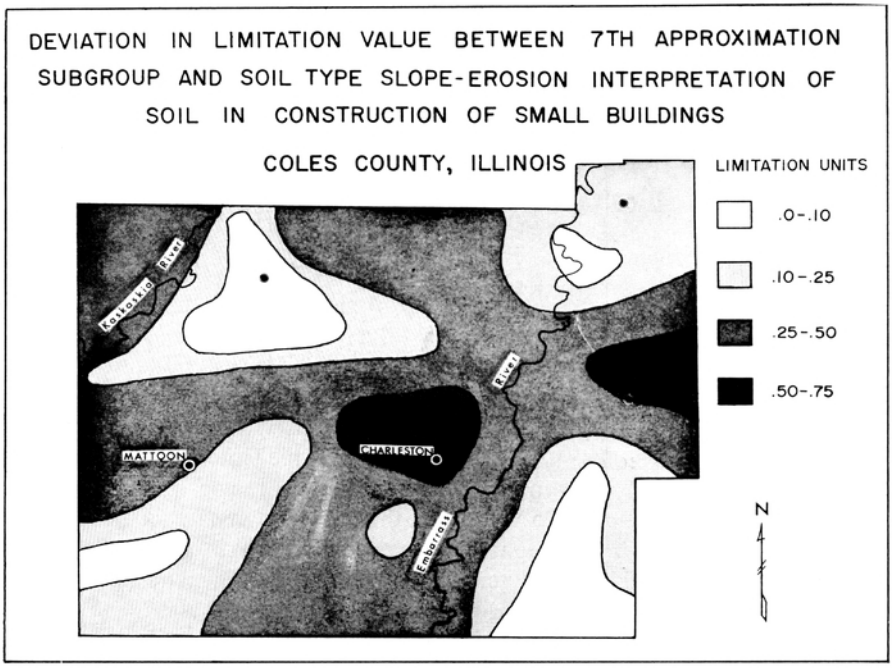

FIGURE 3. — Deviation in Limitation Value Between 7th Approximation Subgroup and Soil Type-Slope-Erosion Interpretation of Soil in the Construction of Small Buildings, Coles County, Illinois.

al soils have the largest areal representation in the region (1949 classification).

Region 4.50-5.00 has very severe limitation for the construction of cottages and utility buildings. In the study area the primary association is between severe limitation and fine-textured soils. Flat terrain and poor drainage are closely associated with the fine-textured soils. This part of the study area is almost completely dominated by Planosol or Planosol-like soils.

From these and other associations it is possible to better understand the factors which are critical in the development of limitation regions. A more detailed analysis of the soil characteristics in the limitation regions can show many more of the intimate interrelationships between soil and the resulting suitability of the land to support a particular land use within its regional framework.

Summary and Conclusions

(1) The results of this study are valid within the given framework which utilizes one county of Illinois, one soil interpretation at one level of the 7th Approximation. Many more detailed studies, using various levels of the 7th Approximation in diverse areas with different types of land use interpretations are required before conclusive statements may be made concerning the applicability of the 7th Approximation in other land limitation studies. This type of application as well as others should be attempted using the 7th Approximation in order to learn more about its character. (2) This study demonstrates conclusively that 7th Approximation subgroup maps can successfully be used for selected land use interpretation studies. (3) Interrelationships between soil characteristics and the suitability of land for constructional purposes can easily and quickly be made by utilizing soils organized within the 7th Approximation subgroup framework. (4) Theoretically, the interpretation of interrelationships between any level of the 7th Approximation and many other earth phenomena is possible in a variety of geographic analyses. Completion of this type of study will aid in a greater geographic understanding of soil and soil-related phenomena.

Acknowledgments

The author wishes to thank Michael Illian and Dr. Dewey Amos of the Geography Department — Eastern Illinois University for their assistance in the cartographic preparation of the paper.

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Manuscript received April 8, 1968.