EDUCATIONAL APPLICATIONS OF DIGITIZED SOIL SURVEYS

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The North Dakota Agricultural Experiment Station Soil Survey of McHenry County Organized Irrigation Districts is approaching publication and represents a first for soil survey in North Dakota. The decision was made to digitize the soil maps to facilitate acreage tabulations and improve methods of generating soil interpretations. While the digitization procedure is costly in terms of start-up labor (programming) and data entry, the benefits allow more flexibility than conventional soil surveys.

The digitizing system has broad applications ranging from computer aided instruction by agricultural extension service staff to uses by private business including generating government agency contracts. There is also a proposal being prepared to utilize the digitizing system as a part of the teaching done in undergraduate soils courses.

The Digitizing Procedure

The digitization process utilizes an IBM-XT microcomputer, a Digi-Pad 5 graphics tablet[1], and a person to do the encoding. The graphics pad consists of a grid of wires spaced 0.5 inches apart which are capable of delivering 0.001 inch resolution when the electronic stylus is drawn over the pad. The high resolution of the graphics pad allows more accurate calculation of area than the older cell-type digitization efforts.

The digitizing procedure (encoding) is done one line segment at a time for each soil map unit or polygon. To facilitate encoding, the progress is shown simultaneously on the video screen of the computer; this allows the encoder to keep track and correct mistakes through a sophisticated set of error trapping statements. The stylus is depressed on a segment node, or intersection, and a beep sounds indicating that x, y coordinates are being sent to the communication buffer. The buffer is the input/output device for the graphics pad, with the first character in being the first character sent out to the IBM computer. The encoder then carefully traces the line segment and again depresses the stylus at the end of the line segment. Each segment in a polygon is stored in a sequential file containing the x, y coordinates of the first node, the coordinate pairs for the segment proper, and the coordinate pairs at the last node. When the segments making up a polygon are completed, the perimeter of the polygon is closed on the video screen. The encoder is querried regarding the polygon and, if all is correct, the polygon is filled with a specific color pattern and the soil symbol is then encoded.

When the encoder moves to an adjacent polygon having line segments in common with the previously digitized polygon, a routine which allows the common segment to be copied is used. Such a routine saves time and ensures accurate acreage counts for each polygon because the mathematical calculation for acreage is based on the length of the line segment.

Keeping the books for this process requires complicated programming. Each soil map contains 13.5 sections and has separate files listing corner coordinate points, number and identity of included sections, and the number of island polygons contained within larger polygons. This latter file is of extreme importance when calculating the acreage for each polygon.

APPLICATIONS

Interpretive maps would be generated in the following manner once a list of similar mapping units is created. The basis for map unit combination is the predicted soil behavior for a specific use. Line segments separating two similar polygons need to be eliminated. The line segment files are then examined for the node coordinates. It is clear that for each segment there will two soil symbols, one encoded when the initial polygon is digitized, the second is encoded when the "copy" of the previously encoded line segment is entered for an adjacent polygon. A comparison program will evaluate adjacent symbols and "tag" those line segments which need to be eliminated for the interpretive map. When the maps are printed on a plotter or a printer the tagged line segments will not be printed and the product is a single factor soils map.

Often, soil survey users are interested in the distribution of a specific soil type in a survey area. An example might be a highway engineer seeking a good source of gravel. With a digitized soil data base geographic distribution can be observed by plotting a map showing only the soil unit or units desired by the user. A table of the acreage for the specific map units can be rapidly printed. Producing maps or tables of map unit distribution by area within the survey is not possible with a conventional soil survey report.

The greatest benefit from the digitized data base will be the ease with which it allows fabrication of general soils maps for specific use criteria. In a soil survey such as McHenry County, the feasibility of irrigation is an important question. A single factor map for soil water holding capacity could be produced with the digitized data set and with greater accuracy and speed than previously possible. This product would only be obtained from a conventional soil survey with a high labor investment. With a digitized data base it is only a function of a list of delineations representing similar soil behavior and some sophisticated programming.

The digitized data base of McHenry County has been found by NDSU experiment station and extension service staff to be an excellent method for disseminating soils information. Geographic distribution of soils mapping units can be highlighted, and tables of acreage pulled up so quickly that producers are eager to use this system to refine their management decisions.

The ability of the technology to help producers refine management decisions regarding potential spring wheat yields and fertilizer use has been used by an extension soils specialist since November of 1985. He has used an IBM portable computer, a JVC briefcase VCR system and a Zenith ZVM-135 monitor as a learning center to introduce this technology to agribusiness people and producers[1]. A video tape regarding present and future uses of soil surveys was produced and is used in conjunction with video material on soil basics and plant nutrition. Computer software is used to predict yield potentials and fertilizer needs based on the soil mapping unit group. These are used via the same computer-video monitor in "Manage for the Most" workshops. The system is interfaced to a Sony 1020Q video computer projector when the audience size exceeds 10-12 people[1]. The audio portion of the video tape has also been used to narrate the computer software. The utility and speed of the system is such that two contracts have already been secured from interested agencies in North Dakota. The learning center concept has resulted an interest demonstrated by the agricultural sector, both public and private, to such an extent that funds are being secured to purchase a video scanning camera which can digitize soil maps much more quickly than the present graphics pad encoding system.

Classroom education is another potential application of the digitized database. Presently a lab module is being prepared for Soils 201 students in the Department of Soil Science at NDSU. Students will act as hypothetical consultants and present their recommendation to a Soil and Water Conservation District concerning the location of a proposed irrigation development. Students will use the digitized soil base and appropriate resources (ie. published soil surveys, North Dakota Correlations Database and Official Series Descriptions) to generate a list of soils which act similarly for a specific use. This list will be the basis of a single factor soils map for irrigation suitability.

The McHenry County Soil Survey database provides an excellent framework for an exercise of this kind. There are 47 soil taxonomic units and 75 mapping units in the survey. The range of soils includes many different parent materials of glacial origin, has several units with water restrictive substrata and finally, runs the gamut of soil drainage and salinity classes. The students will find a challenging exercise in grouping such diverse soils for their report to the "Conservation District". Once the soils are grouped, students can use programs already in place to generate single factor soils maps. This will give them the opportunity to use state of the art technology which they almost surely will use in their future employment in soil science.

[1]The use of trade names does not imply endorsement by North Dakota Agricultural Experiment Station of the products named nor criticism of similar ones not mentioned

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