THE ACCURACY OF SOIL MAPS PREPARED BY VARIOUS METHODS THAT USE AERIAL PHOTOGRAPH INTERPRETATION

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ABSTRACT

Five methods varying in degree of dependence upon aerial photo interpretation were used to map each of two areas representing different degrees of complexity of geologic material and soil pattern. Methods that relied upon aerial photo interpretation alone for final identification of mapping units produced reasonable degrees of accuracy for semi-detailed mapping of features closely correlated with prominent land forms. Increasing complexity of the soil patterns or geologic deposits or increasing importance of properties not closely associated with land forms greatly reduced the accuracy. Maps prepared by these methods should be adequate for objectives that do not require intricate detail in areas where land forms are distinct and well known. Highly detailed maps with high requirements for accuracy, such as those used for farm planning, require field identification and delineation of the areas mapped, in addition to the information provided by aerial photographs.

OBJECTIVES

THE study reported here involved two principal objectives: (a) measurement of the accuracy of soil mapping for agricultural uses by methods that depend to varying degrees on the interpretation of aerial photographs and (b) measurements of the effect of complexity of the landscape on the accuracy of these methods. Within the limitations of time and funds available, an attempt was also made to obtain some indication of variation of accuracy among individuals recognized as competent in their fields.

THE AREAS MAPPED

Two aerial photographs representing areas differing in degree of complexity of soil patterns were selected in the northwestern part of Franklin County, New York within the St. Lawrence Valley Lowland.[2] The land surface of the region slopes gently northwestward from the foot of the Adirondack Mountains to the St. Lawrence River, and local relief in the areas studied ranges from a few feet to a few tens of feet. The soils are developed mainly in unconsolidated deposits of late Wisconsin Glaciation and associated deposits of proglacial lakes and the Champlain Sea.[1] These deposits rest on a late tertiary peneplain which bevels the underlying rock at a low angle.[1,2]

The northernmost of the two areas (Figure 1) was selected because of the relative simplicity of soil pattern and will be referred to as the "simple area." The area is underlain by limestone. The surface deposits are dominated by highly calcareous glacial till in low but clearly defined ridges and marine clays of the Champlain Sea in large flats. Recent alluvium of the Little Salmon River and peat are minor constituents. Although the soil pattern was a simple one for the region, it would be considered complex in relation to many older landscapes in which drainage courses are better established.

The second area (Figure 2) lies six miles south of the simple area and was chosen because of the complexity of the soil pattern and variety of parent materials. It will be referred to as the "complex area." It is underlain by sandstone, and the grain size of the rock is reflected in moderately coarse textures of the associated till. The area was covered by proglacial lakes which account for beaches, sandy deltaic deposits, and clayey lacustrine deposits within the area. Large areas adjacent to beach

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* The authors are indebted to M. E. Austen and F. J. Carlisle of the Soil Conservation Service, D. J. Belcher, Head, Cornell University Center of Integrated Photographic Studies, J. D. Mollard, Air Surveys Engineer, Prairie Farm Rehabilitation Administration of Western Canada, and Lenore Travers, Aerial Photograph Interpreter, New York State Department of Public Works for the ground surveys and aerial photograph interpretations on which the study is based.

FIG. 1. A portion of the standard soil map of the simple area of aerial photograph CXE-3B-77.

deposits have very stony soils high in the coarser grades of sand to a depth of 3 feet, and are believed to be areas of glacial till reworked by wave action of shallow waters. Normal glacial till and recent alluvium are also present.

MAPPING METHODS

Five methods, hereafter designated as *A*, *B*, *C*, *D*, and *E*, were used. In all methods used the base maps were prepared from aerial photographs at a scale of approximately 1:20,000; no method involved mapping without photographs because the superiority of a photographic base had been demonstrated repeatedly. Both methods *A* and *E* were duplicated by different individuals. Duplicates are designated by the numbers 1 and 2 applied to the appropriate symbol for the method.

Method *A* was an interpretation of aerial photographs by two people experienced in aerial photo interpretation for engineering purposes, but not for agricultural uses. They worked independently with no direct knowledge of the area other than its general location, and the fact that it was glaciated. Stereopairs were provided. The interpreters mapped combinations of parent material, drainage, stoniness, slope, and accelerated erosion.

Method *B* was an interpretation of aerial photographs by a person experienced in aerial photo interpretation for engineering uses. In addition, he had been associated with agricultural soil surveys sufficiently to have accurately in mind, concepts of classification units, such as series and phases, and also classes of single factors, such as drainage condition. He was not as familiar with stoniness classes as with drainage, parent material, and the categories of taxonomic classification. He had, however, had only limited experience with field mapping in agricultural soil surveys. He had access to all available literature but had not seen the area. He was provided with stereopairs, a legend of soil types of the region, descriptions and keys of the soils, a soil association map of the region reproducible at a scale of ½ inch to 1 mile, a map of bedrock geology at a similar scale, and a general description of the glacial geology of the region.

Method *C* was an interpretation of aerial photographs by the same individual who prepared interpretation *B*. In this case, however, he studied the area in the field in addition to having all of the information available to him under method *B*. He was

FIG. 2. A portion of the standard soil map of the complex area of aerial photograph CXE-3B-83.

accompanied by an experienced soil surveyor during the field studies, and checked areas that showed special photographic patterns with a soil auger. No boundaries were placed on the photograph in the field; maps were prepared one week after returning to the office. Six and one-half hours were spent field checking the simple area; 13½ hours were spent on the complex area.

Method *D* was comparable to method *C* but was used by an experienced soil surveyor whose experience with interpretation of aerial photographs was confined to their use as base maps in conventional soil surveys. He had mapped soils in the region but had not worked in either of the two areas involved in this study. Method *D*, therefore, involved greater experience with the land forms of the region, but less experience with techniques of photo-interpretation, and less direct knowledge of the specific areas studied than did method *C*.

Method *E* was a ground survey using aerial photographs as base maps. It was duplicated by two experienced soil surveyors working independently and using techniques of the National Cooperative Soil Survey.[3] Mapping was done in the field on alternate photographs supplemented by the use of stereopairs in the office. Photo interpretation was involved to a smaller degree than in other methods, but contributed especially to the location of boundaries. Identification of mapping units depended primarily on field observations.

THE STANDARD MAP FOR APPRAISAL OF ACCURACY

After all of the maps by all of the methods had been completed, transparent copies were prepared and discrepancies among maps were determined by superimposing one over another. Discrepancies were checked in the field, and a standard map was prepared using the best information on all maps, corrected where necessary on the basis of complete detailed field studies of the areas. This map was used as the standard of comparison for all maps by all methods as the most accurate feasible of compilation.

Each mapping unit of the standard map was recorded, and its area was measured with a grid. A transparent copy of the standard map was then superimposed on the map being compared, and the area in agreement was measured and recorded for each mapping unit of the standard.

Areas of disagreement were also measured, and both kinds and acreages of mapping units in disagreement were recorded for each mapping unit of the standard map. These values were divided by the total area of the mapping unit of the standard map, and expressed as per cent agreement or disagreement for that unit. From these data it was possible to derive summaries of per cent agreement and kind and per cent of disagreement with the standard for the mapping of (a) soil units of the taxonomic system of classification, (b) single soil attributes such as parent material, natural drainage, or stoniness and (c) special interpretive groups such as Land Use Capability Classes. Classes of taxonomic categories and of single attributes used were those of the National Cooperative Soil Survey.[3] Land Use Capability Classes were those used by the Soil Conservation Service.[4]

RESULTS AND DISCUSSION

Table 1 shows the per cent accuracy of various methods relative to the standard map rated as 100. Although the relationship is confounded with the personal factor, it appears that interpreters accomplished only small and inconsistent increases of accuracy by reading about the region, if they had not seen the specific areas mapped (methods *A* and *B*). The fact that the individual of method *B* had the advantage not only of access to the literature, but also of experience with criteria for agricultural interpretations, lends weight to this conclusion. Accuracy was very poor for both methods by all criteria except parent material of the simple area. Obviously, in the absence of experience with criteria for agricultural interpretations, interpreters of method *A* could not be expected to differentiate by soil series and soil phase. Nor could they be expected to map accurately classes of stoniness and drainage that conform to agricultural standards. In the case of parent material, which is classified similarly for both agricultural and engineering interpretations, the comparison of methods is valid.

Field checking resulted in consistent increases of accuracy by all criteria (methods *B* and *C*) and was most effective in the complex area. Accuracy remained poor, however, for the complex area but approached satisfactory levels for some criteria in the simple area. There was little difference between the trained interpreter with moderate experience in agricultural surveys who had field checked, and the soil surveyor with limited training in interpretation but with greater knowledge of the soils (Methods *C* and *D*).

TABLE 1

PER CENT OF THE TOTAL AREA MAPPED CORRECTLY IN TERMS OF THE INDICATED CATEGORIES AND ATTRIBUTES BY VARIOUS METHODS

Method	Acres Mapped	Soil Series	Soil Phase	Stoniness	Drainage	Parent Material	Land-Use Capability
			Simple Area				
A1	3,220	—	—	62	—	74	19
A2	3,220	—	—	63	49	85	63
B	3,220	60	26	74	66	81	62
C	3,220	72	54	79	76	89	68
D	3,220	67	55	72	75	81	65
E1	3,220	90	86	94	91	97	90
E2	2,260	79	72	92	80	97	78
			Complex Area				
A1	3,778	—	—	56	—	23	18
A2	3,778	—	—	31	36	24	26
B	3,778	10	4	56	38	43	12
C	3,778	33	28	73	48	67	53
D	2,778	28	25	72	46	60	35
E1	3,778	88	86	95	92	94	90
E2	1,782	78	73	93	83	91	83

The outstanding increase in accuracy by all criteria was associated with the shift from major dependence on photo interpretation to major dependence on field investigation for final delineation and identification of mapping units. In all cases the aerial photograph contributed to location of boundaries (Methods *C* or *D* and *E*). The comparison between *D* and *E2* is most valid in this instance because the same individual prepared both maps.

The complexity of the area had a profound effect on accuracy by all methods that depended primarily on photo interpretation. It had little effect in method *E* where major dependence was placed on field identification.

The data in Table 1 suggest only the amount of absolute agreement with the standard and do not indicate the degree of disagreement. Tables 2 through 4 present data indicating both the amount and degree of error involved in mapping of single factors.

Table 2 shows the degree of error in mapping of natural drainage. From the standpoint of agricultural uses, the boundary between imperfect and poor drainage is more highly significant than the boundary between moderate and good or that between poor and very poor. Photo interpreters who had not seen the area consistently overestimated the degree of natural drainage, and consequently made less important errors in the moderate than in the poor drainage class. Field checking apparently made them overly conscious of the amount of restricted drainage, and methods *C* and *D* overestimated the poor drainage classes.

It should be recognized that the concepts of drainage classes used were not familiar to the individuals of method *A*, and consequently their errors reflect both inadequacies of the method and lack of experience. The mapper of methods *B* and *C* was familiar with the concepts used but had not mapped the classes in the field. The method which depended on field identification resulted in more accurate delineation, but mapper *E2* consistently mapped marginal areas one drainage class lower than the standard. This was responsible for most of the error for this mapper noted in Table 1, and emphasizes the need for standardization of concepts regardless of methods employed.

Table 3 shows how the three most extensive geological materials were mapped by various methods. With the exception of

TABLE 2

ERRORS IN THE MAPPING OF NATURAL DRAINAGE CONDITION BY VARIOUS METHODS

Method	Moderate and imperfect drainage				Poor drainage			
	Acres	Per cent mapped as			Acres	Per cent mapped as		
		Good	Poor	Very poor		Good	Moderate	Very poor
				Simple Area				
A1	976	94	6	0	1,876	96	0	0
A2	976	79	8	0	1,876	24	5	0
B	976	31	12	0	1,876	7	15	4
C	976	0	24	3	1,876	0	14	2
D	976	3	25	0	1,876	1	12	1
E1	976	6	8	1	1,876	0	4	4
E2	577	3	21	1	1,542	0	1	17
				Complex Area				
A1	1,177	89	11	0	1,304	91	0	0
A2	1,177	55	28	2	1,304	26	15	7
B	1,177	28	7	2	1,304	19	55	0
C	1,177	4	45	1	1,304	1	9	0
D	1,177	14	37	19	1,304	6	24	36
E1	1,177	9	4	1	1,304	1	5	2
E2	415	16	8	7	476	1	2	13

TABLE 3

PER CENT OF THE INDICATED GEOLOGICAL MATERIAL MAPPED AS VARIOUS DEPOSITS BY DIFFERENT METHODS

Method	Simple Area					Complex Area				
	Acres	Glacial till	Marine & lake clays	Glacio-fluvium	Wave-worked till	Acres	Glacial till	Marine & lake clays	Glacio-fluvium	Wave-worked till
Glacial Till										
A1	1,371	96	4	0	0	559	99	0	1	0
A2	1,371	92	5	3	0	559	33	0	66	0
B	1,371	77	8	3	12	559	50	0	16	32
C	1,371	85	13	0	0	559	0	68	3	29
D	1,371	82	6	12	0	559	2	16	4	78
E1	1,371	95	5	0	0	559	96	1	1	2
E2	667	93	7	0	0	90[1]	—	—	—	—
			Marine Clays					*Wave-worked Till*		
A1	1,700	39	60	0	0	1,958	93	0	0	6
A2	1,700	19	79	0	0	1,958	44	6	42	6
B	1,700	9	89	0	1	1,958	50	0	22	26
C	1,700	6	92	0	0	1,958	0	1	16	82
D	1,700	9	79	11	0	1,958	0	8	4	86
E1	1,700	2	98	0	0	1,958	1	1	1	95
E2	1,514	1	99	0	0	1,180	4	0	2	94

[1] Not an adequate sample for analysis.

"wave-worked till," all materials were well known to all individuals involved, and differences among methods may be attributed mainly to the methods involved. In the simple area, where glacial till and marine clays were the principal materials and were associated with distinctive land forms, the errors recorded were mainly due to inaccurate plotting of boundaries. Both mappers of method *A* consistently extended the areas of glacial till into the areas of marine clays. Accuracy was good to excellent by all other methods in this area. In the complex area, however, accuracy was very poor for all methods that did not depend on field studies for delineation and identification. The apparently high accuracy of mapper *A*1 for glacial till is not real because he mapped almost the entire area in that class. Field checking

TABLE 4

PER CENT OF THE AREA OF STONY AND VERY STONY SOILS MAPPED AS VARIOUS STONY CLASSES BY DIFFERENT METHODS

Method	Simple Area				Complex Area			
	Acres	Non-stony	Stony	Very stony	Acres	Non-stony	Stony	Very stony
Stony Soils								
A1	986	41	32	27	2,278	39	60	1
A2	970	75	25	0	2,286	97	3	0
B	988	19	57	24	2,280	47	53	0
C	988	17	48	35	2,297	28	71	1
D	1,014	5	49	46	2,272	18	82	0
E1	988	5	86	9	2,278	3	97	0
E2	469	6	83	11	1,052	2	96	2
Very Stony Soils								
A1	399	12	50	38	381	5	60	35
A2	421	60	40	0	372	92	2	6
B	397	7	56	37	379	50	50	0
C	397	12	14	74	361	28	17	55
D	371	1	9	90	386	15	8	77
E1	397	6	4	90	380	4	5	91
E2	214[1]	—	—	—	247[1]	—	—	—

[1] Not an adequate sample for analysis.

resulted in striking increases of accuracy as noted in Table 1, but resulted in glacial till being incorrectly identified as lake clays. It is significant that the major gain in accuracy was accomplished by recognition of the wave-worked till, a material with which the interpreter had had little experience prior to field checking.

Complexity of the area had only minor effects on the accuracy of method *E*, and these were associated largely with incorrect location of boundaries, or inclusion of small areas within a larger area of another kind. Both methods *C* and *D* produced maps with less detail than method *E*, and some of the additional error noted for them is due to inclusion of a higher proportion of such small areas.

Table 4 shows how stoniness was mapped by the different methods. The stony-very stony separation is defined to correspond with the boundary between cultivable and non-cultivable soil[3] and is, therefore, a more important separation than that between non-stony and stony soils for agricultural uses. The data indicate that the stony-very stony separation could not be mapped consistently by aerial photo interpretation, even after field checking. The degree of accuracy is apparently greater in the complex area, but this arises from the fact that the wave-worked till of the area was not differentiated as to degree of stoniness, and that the mapping was considered correct if some stoniness was indicated. Mappers *A*, *B*, and *C* could not be expected to draw the boundary between stony and very stony soils at the same degree of stoniness as mappers more familiar with the classes used. Errors involving non-stony and very stony classes are so frequent, however, that one must conclude that the methods themselves are inadequate for differentiation of this attribute. By method *E*, 92 to 95 per cent of the total area was mapped in agreement with the standard (Table 1) but the important stony-very stony separation was mapped less precisely than the others.

CARTOGRAPHIC DETAIL

Simple inspection of the maps showed striking differences in the size of areas delineated and the number of boundaries drawn by the various methods. Aerial photo interpretation consistently gave larger areas and fewer boundaries by all individuals than did methods of field surveying. The boundaries drawn by aerial photo interpretation were smoothly curving lines; those drawn in the field included a high proportion with intricate small curves fitted to minor extensions of one soil into the general area of an adjacent soil. Maps made in the field included large numbers of small areas that were highly contrasting with the soils around them. The maps prepared by aerial photo interpretation showed few such small areas. A count of delineated areas of less than 6 acres in a sample of 800 acres within the simple area showed an average of 5 such areas for methods *A*, *B*, *C*, and *D* and 44 for method *E*. A similar count of delineated areas of less than 2 acres in size showed an average of 1.6 such areas for methods *A*, *B*, *C*, and *D* and 21 for method *E*. An estimate was made of the total amount of boundaries by counting intercepts on lines of a 0.1 inch grid superimposed on the various maps. For each 100 intercepts by method *E*, there were 52 by methods *A* and *B* and 66 by methods *C* and *D*. These differences in cartographic detail contributed significantly to the magnitude of errors as measured in terms of areal extent.

SIGNIFICANCE OF ERRORS FOR AGRICULTURAL INTERPRETATIONS

The significance of mapping errors for agricultural interpretations involves the integrated effects of the errors discussed above and others not reported. The Land-Use-Capability classification used by the Soil Conservation Service[4] provides a measure of these effects for one kind of applied objective. In this system, classes I, II, and III consist of soils suitable for cropping with varying intensities of management, class IV consists of soils that can safely be cropped only with severe restrictions on the kind and sequence of crops to be grown, and classes VI, VII, and VIII are considered non-crop land. These classes are not mapped directly in agricultural soil surveys but are obtained by grouping map units based on physical properties. For purposes of this study, the mapping has been analyzed in terms of errors that involve the important land use distinctions reflected by these groups of classes, and the analysis is presented in Table 5.

In the simple area, aerial photo interpretation of methods *A* through *D* pro-

TABLE 5

PER CENT OF THE AREA OF SOILS OF MAJOR LAND-USE CAPABILITY GROUPS MAPPED IN VARIOUS GROUPS BY THE INDICATED METHODS

Method	Simple Area				Complex Area			
	Acres	Crop land	Limited cropping	Non-crop land	Acres	Crop land	Limited cropping	Non-crop land
				Crop Land				
A1	2,490	84	4	12	1,749	82	11	7
A2	2,490	95	5	0	1,749	77	20	3
B	2,490	82	18	0	1,749	55	42	7
C	2,490	82	15	3	1,749	74	3	23
D	2,490	78	16	6	1,749	45	14	41
E1	2,490	94	5	1	1,749	98	1	1
E2	1,924	81	18	1	589	77	4	24
		Limited Cropping				*Non-crop Land*		
A1	548	60	14	26	1,842	71	19	10
A2	548	71	26	3	1,842	40	52	8
B	548	52	48	0	1,842	75	24	1
C	548	37	50	13	1,842	16	3	81
D	548	36	50	14	1,842	11	1	88
E1	548	6	92	2	1,842	7	2	91
E2	283[1]	—	—	—	1,076	2	1	97

[1] Not an adequate sample for analysis.

vided map units that, upon interpretation, considerably overestimated the acreage suitable for cropping. This resulted in an apparent high degree of accuracy for the crop land values but low for the area suited to limited cropping. Acreages of non-crop land were too small to justify analysis. In the complex area results were erratic among methods. Method *E* gave more consistently accurate results than the other methods, and Table 1 suggests that its accuracy was affected little by complexity of the area. The error of mapper *E*2 for crop land of the complex area, however, was a serious one, involving classification of about 140 acres suited to limited cropping as non-crop land. It arises from identification of natural drainage of marginal areas one class lower than the standard, and again emphasizes the importance of standardization of concepts.

The data of Table 6 indicate the errors involved in the more refined distinctions that reflect intensity of soil management needs within land-use classes. Differentiation of crop land needing simple practices from that needing complex practices was very poor in the complex area by aerial photo interpretation, both with and without field checking. Moderately good results were obtained with field checking in the simple area.

TABLE 6

PER CENT OF THE CROP LAND AREA NEEDING COMPLEX MANAGEMENT PRACTICES MAPPED IN VARIOUS LAND-USE-CAPABILITY CLASSES BY THE INDICATED METHODS

Method	Simple Area					Complex Area				
	Acres	Simple practices	Complex practices	Limited use	Non-crop land	Acres	Simple practices	Complex practices	Limited use	Non-crop land
A1	1,759	76	16	2	6	1,346	59	22	12	7
A2	1,759	26	70	4	0	1,346	21	52	23	4
B	1,759	12	75	3	0	1,346	33	20	45	2
C	1,759	9	84	7	0	1,346	18	54	3	25
D	1,759	3	84	8	5	1,346	32	13	16	39
E1	1,759	3	93	3	1	1,346	6	92	0	2
E2	1,473	1	82	17	0	452	7	70	6	17

Conclusions

Methods that rely upon aerial photo interpretation alone for final identification of mapping units produce less detailed and less accurate soil maps of young landscapes than do those which rely upon field identification and delineation but use aerial photo interpretation to guide the placement of boundaries. Increasing complexity of the landscape greatly reduces the accuracy of aerial photo interpretation, but affects field survey methods using aerial photographs to only minor degrees. Increasing importance of soil properties not associated with prominent land forms also greatly reduces the accuracy of aerial photo interpretation. Field survey methods using aerial photographs are much less dependent upon such association with land form.

Methods that rely upon aerial photo interpretation for identification of mapping units produce moderate to good degrees of accuracy for semi-detailed mapping of geologic materials in simple landscapes, and would produce satisfactory maps for engineering uses that do not require intricate detail. They may also be used satisfactorily for generalized maps showing catenary associations for agricultural uses, and would probably be superior to field methods of reconnaissance surveys for such purposes. Field checking is essential for reasonable degrees of accuracy for most objectives, the major exceptions being those which require only the mapping of characteristics closely correlated with prominent and well known land forms. These methods, with or without field checking, do not satisfy standards of accuracy required of maps used for farm planning.

Methods that rely upon field identification of mapping units, but use aerial photographs to guide the placement of boundaries, are necessary for the detailed soil maps needed for objectives such as farm planning in most landscapes. Such methods may be expected to produce degrees of accuracy ranging from 80 to 90 per cent in most instances when used by competent surveyors. Occasional errors as great as 30 per cent should be expected of even experienced surveyors in the mapping of some of the least prominent features. Special emphasis should be placed upon standardization of criteria for the mapping of such attributes as stoniness and natural drainage.

Literature Cited

1. Fairchild, H. 1919. "Pleistocene Marine Submergence of the Hudson, Champlain, and St. Lawrence Valleys." *New York State Museum Bulletin* 209–210. 76 pp.
2. Fenneman, N. M. 1938. "Physiography of Eastern United States." McGraw-Hill, New York. 691 pp.
3. Soil Survey Staff. 1951. "Soil Survey Manual," *USDA Handbook* No. 18, 503 pp.
4. Steele, J. G. 1951. "The Measure of our Land," *USDA, SCS pub.* PA 128. 17 pp.

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