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Distribution of Soils by Natural Drainage Class and by Slope Class for Iowa Counties

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Abstract. Natural drainage class (namely, poor, imperfect, and well drained) and slope class are estimated for Iowa counties through a 2% 1/4-section sample soil survey. Estimate of soil drainage class is given also by slope class. Counties vary widely in the amount of poorly drained soils. Kossuth County has 56.4% of poorly drained soils, while Allamakee has less than 1%. Land use management and conservation considerations are discussed briefly.

The degree to which Iowa soils become wet or near water-saturated affects their capability for crop use. It also affects their use and management for other purposes; for example, as sites for homes, roads, airports, and solid waste disposal.

Iowa counties differ widely in the amount of soil that is seasonally wet. It is the objective of this study to present information on county and state distribution of soils of differing slope and drainage class.

Three degrees of natural wetness are used in this study. They are corn crop-production biased and are: (a) poorly drained, (b) imperfectly or somewhat poorly drained, and (c) well drained. Poorly drained soils are commonly seasonally water-saturated. If cultivated, they are usually tile drained, if permeable enough. Imperfectly drained soils may be in need of some drainage improvement in some seasons. Well drained soils are seldom in need of drainage improvement. Criteria for placing soils in a drainage class are discussed later.

Seven slope classes of soils are used, and slope class of drainage class is given.

DATA

This study used the data collected from a 2%, stratified, random sample of the land area in Iowa. Soil mapping started in 1947. Each soil mapped was identified by soil profile, slope class, and erosion class. The Soil Conservation Service was responsible for mapping three individual 1/4-section tracts per township. This sampling technique was later adopted by the USDA to study the

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soils and the conservation needs throughout the entire country. The nationwide study has been named the National Conservation Needs Inventory. The Conservation Needs Inventory data for Iowa were presented elsewhere (Iowa Conservation Needs Committee, 1963).

Two papers have presented some soil drainage and soil slope data (Arnold et al. 1960; Slusher et al. 1961). The "depressional" soils data of north-central Iowa of Slusher et al. are included in our "poorly drained" soils. Geometrical properties of these depression have been investigated by Haan and Johnson (1967). The soil slope data of Arnold et al. are essentially similar to the slope data of this paper.

The report is presented in three sections. In the first section, soils are identified as belonging to one of three natural drainage classes: poor—needing drainage; imperfectly, or somewhat poorly, drained—sometimes needing drainage, particularly in the more northern areas of Iowa; and well drained—not needing drainage. Included in this section is a discussion of the criteria used in establishing natural drainage class.

The second section gives the percentage of the drainage classes of each county in each of the various slope classes (Table 1). The estimated acreage of each of the various mutual drainage and slope classes may be determined by multiplying the percentage of each class by the total acres in the county.

The third section gives some implications of the slope-drainage data to use, management, and conservation of Iowa soil resources.

IDENTIFICATION OF SOILS BY NATURAL DRAINAGE CLASS

Each soil mapped in the sample soil survey was assigned to one of the three natural drainage classes. The color of the subsoil, usually the 12-to 36-inch layer, is considered diagnostic and is given major emphasis in placing the soil in a drainage class. Important colors considered include those affected by the content, form, and distribution of iron in the subsoil (Dideriksen, 1966; Runge and de Leon, 1967). Surface horizons are also used, but overall they are not as important as the subsoil. Most soils of the study are easily assigned to a drainage class, but some are difficult to place. This is particularly true of the soils formed from alluvium. Where color gave indefinite criteria for determining drainage class, other soil morphological features, landscape position, and experience of soil scientists with the soil in question were used in placing it in a drainage class.

In Iowa, most poorly drained soils have gray to olive gray subsoils. These subsoil horizons have Munsell color hues of 2.5Y to 5Y with values between 3 and 7 and chroma of 2 or less. If values

Table 1. The Distribution of Soils by Slope and Natural Drainage Class for all Iowa Counties.

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	Excluded Area
Adair	All classes	100.0	8.9	24.3	22.8	30.9	7.8	2.6	—	2.7
364,166	Poor	7.49	3.95	2.96	0.10	0.48	—	—	—	—
	Imperfect	15.75	2.89	8.27	1.16	3.33	0.10	—	—	—
	Well	74.04	2.08	13.06	21.50	27.11	7.65	2.64	—	—
Adams	All classes	100.0	17.7	26.6	20.4	23.1	7.0	2.2	0.8	2.2
272,641	Poor	15.29	9.21	2.83	1.83	1.30	0.12	—	—	—
	Imperfect	19.91	5.18	11.08	2.13	1.52	—	—	—	—
	Well	62.61	3.30	12.72	16.42	20.29	6.86	2.15	0.87	—
Allamakee	All classes	100.0	9.0	7.9	17.1	31.9	1.0	1.0	28.8	2.3
423,681	Poor	0.07	—	.07	—	—	—	—	—	—
	Imperfect	2.48	1.47	1.01	—	—	—	—	—	—
	Well	94.17	7.55	6.85	17.05	31.92	1.00	1.01	28.79	—
Appanoose	All classes	100.0	12.8	21.0	21.6	15.7	15.7	6.9	6.0	0.3
334,720	Poor	11.94	11.35	.57	0.02	—	—	—	—	—
	Imperfect	36.70	—	18.42	17.33	0.95	—	—	—	—
	Well	51.06	1.47	2.08	4.21	14.70	15.70	6.90	6.00	—
Audubon	All classes	100.0	6.4	26.3	16.2	34.3	10.7	4.8	0.2	1.1
286,721	Poor	6.11	6.04	0.03	—	0.04	—	—	—	—
	Imperfect	17.81	.34	15.73	1.21	0.36	0.09	0.08	—	—
	Well	74.98	.02	10.57	15.00	33.85	10.65	4.73	0.16	—
Benton	All classes	100.0	9.4	53.2	19.8	6.5	3.7	2.2	0.6	4.6
459,522	Poor	16.56	3.70	12.86	—	—	—	—	—	—
	Imperfect	14.02	4.18	8.60	1.24	—	—	—	—	—
	Well	64.88	1.60	31.71	18.60	6.48	3.72	2.18	0.59	—

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	Excluded Area
Black Hawk	All classes	100.0	36.0	42.6	13.0	0.5	0.1	0.1	0.1	7.6
363,519	Poor	18.16	13.78	4.38	—	—	—	—	—	—
	Imperfect	23.73	13.45	10.18	0.11	—	—	—	—	—
	Well	50.45	8.75	28.06	12.94	0.46	0.07	0.06	0.11	—
Boone	All classes	100.0	33.5	48.3	10.0	1.6	0.6	—	3.4	3.1
366,725	Poor	33.97	31.56	2.41	—	—	—	—	—	—
	Imperfect	19.56	1.74	17.82	—	—	—	—	—	—
	Well	43.76	0.16	27.99	10.00	1.62	0.61	—	3.38	—
Bremer	All classes	100.0	48.0	43.6	3.6	0.8	0.2	0.5	0.2	3.1
280,962	Poor	24.70	21.65	3.05	—	—	—	—	—	—
	Imperfect	45.43	22.37	22.93	0.13	—	—	—	—	—
	Well	26.78	4.02	17.65	3.47	0.80	0.15	0.53	0.16	—
Buchanan	All classes	100.0	27.4	59.9	7.7	0.4	0.5	—	0.3	3.9
364,160	Poor	17.05	11.75	5.30	—	—	—	—	—	—
	Imperfect	30.75	8.02	22.43	0.30	—	—	—	—	—
	Well	48.34	7.67	32.14	7.37	0.39	0.52	—	0.25	—
Buena Vista	All classes	100.0	45.0	41.6	7.5	1.3	0.8	0.4	2.8	0.7
369,917	Poor	29.75	29.40	0.35	—	—	—	—	—	—
	Imperfect	19.29	13.33	5.95	0.01	—	—	—	—	—
	Well	50.35	2.24	35.28	7.47	1.36	0.83	0.40	2.77	—
Butler	All classes	100.0	44.1	37.2	10.1	3.7	0.5	0.5	0.2	3.7
372,480	Poor	32.34	28.82	3.52	—	—	—	—	—	—
	Imperfect	24.20	10.98	12.73	0.49	—	.01	—	—	—
	Well	39.75	4.32	20.92	9.63	3.75	0.50	0.47	0.16	

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	Excluded Area
Calhoun 366,720	All classes	100.0	61.3	31.8	2.9	0.3	0.3	0.3	0.1	3.0
	Poor	52.10	52.10	—	—	—	—	—	—	—
	Imperfect	26.04	6.60	19.44	—	—	—	—	—	—
	Well	18.88	2.63	12.39	2.91	0.33	0.33	0.25	0.04	—
Carroll 367,360	All classes	100.0	15.3	40.2	21.1	14.8	3.3	0.8	0.7	3.8
	Poor	12.05	11.88	0.17	—	—	—	—	—	—
	Imperfect	19.92	3.02	16.26	0.64	—	—	—	—	—
	Well	64.20	0.43	23.68	20.51	14.82	3.31	0.79	0.66	—
Cass 357,666	All classes	100.0	9.0	33.5	18.0	31.0	8.2	0.3	0.1	—
	Poor	8.35	6.21	1.63	0.01	0.20	0.30	—	—	—
	Imperfect	16.04	0.08	15.76	0.20	—	—	—	—	—
	Well	75.61	2.71	16.08	17.72	30.82	7.98	0.27	0.03	—
Cedar 374,401	All classes	100.0	16.6	40.6	22.0	9.9	4.9	2.1	0.6	3.3
	Poor	6.87	6.65	0.22	—	—	—	—	—	—
	Imperfect	16.45	6.99	9.46	—	—	—	—	—	—
	Well	73.30	2.98	30.95	21.95	9.91	4.90	2.10	0.61	—
Cerro Gordo 368,640	All classes	100.0	45.7	34.9	6.9	2.7	1.6	1.6	0.6	6.0
	Poor	32.83	31.19	1.64	—	—	—	—	—	—
	Imperfect	22.80	8.79	13.91	0.10	—	—	—	—	—
	Well	38.36	5.79	19.38	6.79	2.72	1.57	1.55	0.56	—
Cherokee 366,720	All classes	100.0	16.3	46.2	22.1	2.9	1.6	1.5	4.4	5.0
	Poor	11.30	8.83	2.47	—	—	—	—	—	—
	Imperfect	13.78	2.86	10.48	0.44	—	—	—	—	—
	Well	65.61	4.65	33.27	21.65	2.87	1.63	1.54	4.38	—

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Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Chickasaw 323,200	All classes	100.0	37.9	52.7	5.4	0.1	0.1	—	—	3.9
	Poor	27.33	22.47	4.86	—	—	—	—	—	—
	Imperfect	24.15	9.74	13.83	0.58	—	—	—	—	—
	Well	44.64	5.72	34.01	4.79	0.10	0.02	—	—	—
Clarke 274,563	All classes	100.0	13.2	18.0	25.0	14.3	16.4	6.7	2.2	4.2
	Poor	10.62	7.26	2.59	0.59	0.18	—	—	—	—
	Imperfect	40.67	0.43	14.04	21.79	4.30	0.11	—	—	—
	Well	44.61	5.55	1.39	2.65	9.86	16.26	6.72	2.18	—
Clay 367,356	All classes	100.0	54.3	35.5	7.2	1.7	0.4	0.2	0.6	0.1
	Poor	19.80	18.40	1.40	—	—	—	—	—	—
	Imperfect	33.66	24.54	9.12	—	—	—	—	—	—
	Well	46.43	11.37	25.00	7.18	1.74	0.40	0.18	0.56	—
Clayton 509,440	All classes	100.0	5.1	15.5	21.7	23.4	13.7	6.3	8.9	5.4
	Poor	1.30	1.00	0.30	—	—	—	—	—	—
	Imperfect	3.71	1.37	2.32	0.02	—	—	—	—	—
	Well	89.67	2.80	12.88	21.67	23.37	13.70	6.29	8.96	—
Clinton 444,800	All classes	100.0	30.5	27.6	14.4	10.9	5.2	5.4	1.0	5.0
	Poor	16.17	15.74	0.11	—	0.05	0.12	0.15	—	—
	Imperfect	15.10	10.97	4.13	—	.01	—	—	—	—
	Well	63.77	3.79	23.39	14.38	10.89	5.04	5.25	1.03	—
Crawford 458,245	All classes	100.0	8.7	19.1	21.0	29.9	11.1	5.5	1.7	2.9
	Poor	3.91	3.91	—	—	—	—	—	—	—
	Imperfect	5.39	0.07	5.22	1.10	—	—	—	—	—
	Well	86.75	4.75	13.89	19.89	29.94	11.05	5.45	1.78	—

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Dallas	All classes	100.0	27.3	43.1	10.2	6.3	5.0	2.6	3.1	2.4
382,083	Poor	25.40	23.28	2.10	0.02	—	—	—	—	—
	Imperfect	12.25	1.91	10.32	—	0.02	—	—	—	—
	Well	59.97	2.14	30.66	10.17	6.22	5.03	2.64	3.11	—
Davis	All classes	100.0	22.9	22.3	20.0	16.1	9.2	4.6	1.6	3.3
325,760	Poor	21.87	18.75	3.12	—	—	—	—	—	—
	Imperfect	43.15	0.31	18.48	16.57	7.79	—	—	—	—
	Well	31.69	3.92	0.66	3.43	8.26	9.23	4.61	1.58	—
Decatur	All classes	100.0	11.9	17.6	20.7	18.9	20.4	6.6	1.4	2.5
339,196	Poor	12.60	8.06	4.47	0.07	—	—	—	—	—
	Imperfect	24.61	—	11.81	12.40	0.40	—	—	—	—
	Well	60.24	3.82	1.32	8.19	18.46	20.45	6.65	1.35	—
Delaware	All classes	100.0	18.2	46.6	15.9	6.7	4.0	1.7	3.4	3.5
366,720	Poor	7.27	4.21	3.06	—	—	—	—	—	—
	Imperfect	20.41	7.28	13.11	0.02	—	—	—	—	—
	Well	68.86	6.75	30.47	15.88	6.72	3.95	1.69	3.40	—
Des Moines	All classes	100.0	33.0	26.7	16.9	6.8	4.4	2.5	3.9	5.8
270,723	Poor	17.63	16.49	1.14	—	—	—	—	—	—
	Imperfect	15.69	12.04	3.35	0.30	—	—	—	—	—
	Well	60.77	4.45	22.21	16.64	6.81	4.40	2.50	3.86	—
Dickinson	All classes	100.0	32.8	38.4	15.9	3.6	2.3	0.9	0.4	5.7
255,806	Poor	22.91	20.77	2.14	—	—	—	—	—	—
	Imperfect	22.25	8.99	13.23	0.03	—	—	—	—	—
	Well	49.20	3.07	23.07	15.87	3.61	2.31	0.85	0.43	—

Table 1.   Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Dubuque 398,083	All classes	100.0	3.5	12.2	18.1	31.5	18.0	4.7	6.3	5.7
	Poor	1.22	0.73	0.41	—	—	—	—	—	—
	Imperfect	2.24	0.41	1.54	—	—	—	—	—	—
	Well	92.76	2.41	8.33	18.10	31.54	17.99	4.65	6.34	—
Emmet 257,280	All classes	100.0	36.2	31.5	19.6	6.0	1.8	3.8	0.1	1.0
	Poor	28.03	25.87	4.52	—	—	—	—	—	—
	Imperfect	17.72	9.60	9.67	—	—	—	—	—	—
	Well	53.31	3.73	20.19	19.60	6.53	1.80	3.80	0.17	—
Fayette 465,924	All classes	100.0	12.9	53.5	13.5	6.6	6.0	3.0	3.3	1.2
	Poor	12.58	2.25	10.33	—	—	—	—	—	—
	Imperfect	11.11	4.52	6.24	0.35	—	—	—	—	—
	Well	75.05	6.14	36.87	13.14	6.60	6.03	2.96	3.29	—
Floyd 321,920	All classes	100.0	48.0	42.8	4.3	0.4	0.5	0.1	—	3.9
	Poor	29.02	24.50	4.46	0.06	—	—	—	—	—
	Imperfect	35.16	15.38	19.04	0.74	—	—	—	—	—
	Well	32.00	8.24	19.38	3.46	0.40	0.47	0.05	—	—
Franklin 375,040	All classes	100.0	41.2	42.2	10.7	2.4	0.5	0.3	0.1	2.6
	Poor	30.78	29.33	1.45	—	—	—	—	—	—
	Imperfect	22.00	7.49	14.22	0.29	—	—	—	—	—
	Well	44.66	4.37	26.54	10.42	2.40	0.53	0.33	0.07	—
Fremont 333,440	All classes	100.0	38.7	19.3	9.5	20.6	2.9	2.5	2.2	4.3
	Poor	12.52	12.52	—	—	—	—	—	—	—
	Imperfect	11.21	6.37	4.17	0.09	0.58	—	—	—	—
	Well	71.93	19.83	15.11	9.38	20.05	2.94	2.45	2.17	—

Table 1.   Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Greene 364,160	All classes	100.0	42.8	41.6	7.1	1.3	0.7	0.1	2.4	4.0
	Poor	39.75	39.75	—	—	—	—	—	—	—
	Imperfect	19.05	2.80	16.25	—	—	—	—	—	—
	Well	37.22	0.27	25.38	7.15	1.26	0.74	0.04	2.38	—
Grundy 320.631	All classes	100.0	35.0	48.8	13.1	0.8	0.1	—	—	2.2
	Poor	24.99	24.96	0.03	—	—	—	—	—	—
	Imperfect	27.51	8.53	18.91	0.07	—	—	—	—	—
	Well	45.27	1.49	29.85	13.03	0.82	0.08	—	—	—
Guthrie 381,441	All classes	100.0	19.1	26.7	18.5	17.3	9.7	2.6	3.9	2.2
	Poor	12.77	10.62	2.07	0.04	0.04	—	—	—	—
	Imperfect	18.11	7.72	8.30	0.07	2.02	—	—	—	—
	Well	66.88	0.74	16.32	18.37	15.24	9.67	2.54	4.00	—
Hamilton 369,882	All classes	100.0	58.2	33.1	4.4	1.1	0.4	0.4	2.4	0.1
	Poor	50.97	48.99	1.98	—	—	—	—	—	—
	Imperfect	24.33	9.13	15.20	—	—	—	—	—	—
	Well	24.67	0.05	15.95	4.41	1.14	0.37	0.37	2.36	—
Hancock 366,105	All classes	100.0	59.1	27.3	8.3	1.8	1.4	0.4	0.4	1.3
	Poor	48.26	43.86	4.40	—	—	—	—	—	—
	Imperfect	20.22	10.92	9.29	0.01	—	—	—	—	—
	Well	30.24	4.35	13.60	8.31	1.83	1.35	0.40	0.43	—
Hardin 367,360	All classes	100.0	37.4	38.3	14.9	3.2	0.7	0.6	0.1	4.8
	Poor	30.80	30.58	0.22	—	—	—	—	—	—
	Imperfect	17.24	5.05	12.19	—	—	—	—	—	—
	Well	47.26	1.74	25.90	14.94	3.25	0.65	0.60	0.09	—

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	Excluded Area
Harrison	All classes	100.0	33.1	13.4	13.6	11.4	10.7	7.6	8.1	2.1
447,376	Poor	9.69	9.36	0.33	—	—	—	—	—	—
	Imperfect	7.52	5.77	1.17	0.58	—	—	—	—	—
	Well	80.72	17.99	11.90	13.07	11.39	10.70	7.57	8.10	—
Henry	All classes	100.0	25.8	26.8	23.5	10.0	6.0	2.7	0.6	4.6
281,604	Poor	22.59	21.57	1.02	—	—	—	—	—	—
	Imperfect	23.92	3.95	9.57	7.58	2.82	—	—	—	—
	Well	48.89	0.31	16.16	15.90	7.19	6.03	2.65	0.65	—
Howard	All classes	100.0	36.1	53.7	6.6	0.8	0.1	—	0.1	2.6
301,438	Poor	30.77	21.16	9.61	—	—	—	—	—	—
	Imperfect	36.69	9.84	24.82	1.92	0.07	—	—	0.04	—
	Well	29.87	5.09	19.26	4.65	0.73	0.14	—	—	—
Humboldt	All classes	100.0	52.4	39.3	2.5	0.6	0.6	—	0.8	3.8
378,404	Poor	24.76	24.61	0.15	—	—	—	—	—	—
	Imperfect	20.80	1.28	19.52	—	—	—	—	—	—
	Well	50.66	26.47	19.63	2.50	0.64	0.60	—	0.82	—
Ida	All classes	100.0	5.4	33.3	29.2	24.4	5.6	1.8	0.3	—
276,542	Poor	5.78	3.86	1.92	—	—	—	—	—	—
	Imperfect	8.10	0.12	7.60	0.38	—	—	—	—	—
	Well	86.11	1.42	23.78	28.85	24.40	5.56	1.76	0.33	—
Iowa	All classes	100.0	23.7	20.6	15.1	21.0	10.4	3.9	2.5	2.8
373,760	Poor	7.41	7.32	—	—	—	0.03	0.06	—	—
	Imperfect	21.96	9.64	9.60	—	1.34	1.38	—	—	—
	Well	67.86	6.78	10.96	15.09	19.70	9.02	3.82	2.54	—

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Jackson 414,120	All classes	100.0	8.2	8.7	14.8	29.8	17.9	8.3	11.9	0.4
	Poor	1.41	1.06	0.32	0.03	—	—	—	—	—
	Imperfect	5.59	0.87	4.60	0.09	0.03	—	— —	—	—
	Well	92.65	6.33	3.82	14.63	29.80	17.93	8.29	11.85	—
Jasper 471,040	All classes	100.0	20.3	25.7	20.7	20.6	9.1	2.2	0.4	1.0
	Poor	12.42	10.40	1.54	—	0.19	0.29	— —	—	—
	Imperfect	30.12	6.37	14.72	7.35	1.68	— —	— —	—	—
	Well	56.49	3.48	9.42	13.39	18.71	8.86	2.24	0.39	—
Jefferson 279,044	All classes	100.0	25.0	22.2	25.0	9.9	9.5	5.4	0.2	2.8
	Poor	21.09	21.09	—	—	—	—	—	—	—
	Imperfect	33.50	—	13.69	17.15	2.57	0.09	—	—	—
	Well	42.59	3.90	8.47	7.84	7.30	9.44	5.41	0.23	—
Johnson 396,800	All classes	100.0	23.0	25.4	16.1	15.0	6.6	2.2	2.2	9.5
	Poor	7.51	6.98	0.49	—	—	0.04	—	—	—
	Imperfect	17.71	10.56	5.98	0.01	1.02	0.06	0.08	—	—
	Well	65.34	5.45	18.92	16.07	14.03	6.50	2.12	2.25	—
Jones 375,308	All classes	100.0	12.4	33.3	21.4	12.9	6.7	7.5	2.2	3.6
	Poor	5.52	3.49	2.03	—	—	—	—	—	—
	Imperfect	14.09	6.38	7.71	—	—	—	—	—	—
	Well	76.86	2.57	23.55	21.37	12.94	6.76	7.46	2.21	—
Keokuk 370,582	All classes	100.0	25.5	29.7	22.3	17.9	3.8	0.8	.....	.....
	Poor	1.67	1.57	0.10	— -	......	- - -	—.	—	—
	Imperfect	20.49	15.93	4.47	---	0.09	-	—	- - -	—
	Well	77.84	8.04	25.13	22.28	17.83	3.75	0.81	—.	—

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Kossuth	All classes	100.0	35.4	50.5	8.4	1.0	0.3	0.5	0.2	3.7
626,557	Poor	56.44	34.68	21.76	—	— —	— —	—	—	—
	Imperfect	13.00	0.38	12.62	—	—	—	—	—	—
	Well	26.81	0.29	16.11	8.37	0.98	0.26	0.55	0.25	—
Lee	All classes	100.0	19.3	33.3	15.9	8.5	2.8	2.7	8.4	9.1
348,800	Poor	17.35	15.61	1.18	0.26	0.12	0.14	0.02	— —	—
	Imperfect	43.08	0.45	20.28	14.41	7.94	—	—	—	—
	Well	30.47	3.25	11.84	1.21	0.45	2.72	2.64	8.38	—
Linn	All classes	100.0	15.0	42.8	21.3	4.3	2.4	1.4	1.6	11.2
458,883	Poor	7.79	4.00	3.79	—	—	—	—	—	—
	Imperfect	19.61	8.02	11.55	0.04	—	—	—	—	—
	Well	63.38	2.99	27.43	21.31	4.26	2.43	1.40	1.56	—
Louisa	All classes	100.0	38.2	26.1	11.4	5.4	5.5	5.4	3.6	4.4
267,521	Poor	20.89	20.12	0.64	0.13	—	—	—	—	—
	Imperfect	10.86	9.31	1.40	0.15	—	—	—	—	—
	Well	63.81	8.77	24.09	11.06	5.44	5.53	5.36	3.56	— —
Lucas	All classes	100.0	15.0	28.1	18.7	10.4	9.4	14.9	3.5	—
277,760	Poor	12.7	11.9	0.8	—	—	—	—	—	—
	Imperfect	32.5	2.1	17.7	12.7	—	—	—	—	—
	Well	54.8	1.0	9.6	6.0	10.4	9.4	14.9	3.5	—
Lyon	All classes	100.0	24.4	51.6	17.1	2.8	0.6	0.5	2.0	1.0
376,326	Poor	10.27	9.76	0.56	—	—	—	—	—	—
	Imperfect	13.18	6.26	6.92	—	—	—	—	—	—
	Well	75.43	8.39	44.06	17.09	2.80	0.60	0.53	1.96	— —

Table 1.   Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	Excluded Area
Madison 361,596	All classes	100.0	24.4	19.8	22.2	10.5	7.0	7.5	2.2	6.4
	Poor	12.09	9.41	2.55	0.13	—	—	—	—	—
	Imperfect	16.00	9.01	2.97	2.64	1.38	—	—	—	—
	Well	65.53	5.96	14.28	19.41	9.13	7.04	7.46	2.25	—
Mahaska 366,073	All classes	100.0	16.9	26.3	27.4	19.9	3.8	1.1	—	4.6
	Poor	16.18	14.50	1.65	—	—	—	—	—	—
	Imperfect	13.54	1.69	9.59	1.86	0.45	—	—	—	—
	Well	65.50	0.75	15.00	25.43	19.44	3.85	1.13	—	—
Marion 364,805	All classes	100.0	15.9	20.7	27.1	21.4	7.3	2.1	0.2	5.3
	Poor	10.56	7.23	2.91	0.39	0.03	—	—	—	—
	Imperfect	26.39	2.31	13.45	9.48	1.15	—	—	—	—
	Well	57.77	6.38	4.34	17.21	20.26	7.35	2.06	0.17	—
Marshall 367,341	All classes	100.0	22.6	29.4	29.6	14.1	3.8	0.4	0.1	0.1
	Poor	8.14	6.90	1.24	—	—	—	—	—	—
	Imperfect	12.47	10.94	7.53	—	—	—	—	—	—
	Well	73.36	4.74	20.65	29.55	14.14	3.82	0.37	0.09	—
Mills 285,440	All classes	100.0	18.0	25.1	18.4	20.2	8.6	3.8	1.6	4.3
	Poor	8.23	7.86	0.37	—	—	—	—	—	—
	Imperfect	9.41	1.95	7.15	—	0.13	0.18	—	—	—
	Well	78.04	8.20	17.53	18.43	20.07	8.38	3.84	1.59	—
Mitchell 298,880	All classes	100.0	61.1	30.5	2.3	1.2	0.4	0.3	0.3	3.9
	Poor	20.30	20.07	0.17	0.06	—	—	—	—	—
	Imperfect	28.45	22.09	5.99	0.37	—	—	—	—	—
	Well	47.35	18.92	24.31	1.84	1.24	0.35	0.34	0.35	—

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	Excluded Area
Monona	All classes	100.0	46.9	8.5	7.8	7.9	11.7	5.3	9.7	2.2
454,398	Poor	22.25	22.25	—	—	—	—	—	—	—
	Imperfect	10.39	10.39	—	—	—	—	—	—	—
	Well	65.07	14.29	8.49	7.80	7.85	11.65	5.34	9.65	—
Monroe	All classes	100.0	10.9	18.4	24.2	18.5	11.0	10.3	4.4	2.3
278,402	Poor	12.09	7.15	4.55	0.30	0.09	—	—	—	—
	Imperfect	34.68	1.58	11.03	19.44	2.63	—	—	—	—
	Well	51.03	2.18	2.82	4.47	15.78	10.98	10.35	4.45	—
Montgomery	All classes	100.0	19.2	31.8	12.9	28.5	2.1	0.9	0.5	4.1
270,080	Poor	9.11	8.60	—	0.08	0.43	—	—	—	—
	Imperfect	17.61	2.04	12.28	0.26	2.99	0.04	—	—	—
	Well	69.21	8.53	19.56	12.59	25.13	2.06	0.86	0.48	—
Muscatine	All classes	100.0	42.4	32.3	12.4	5.7	3.0	1.5	2.5	0.2
287,964	Poor	16.44	14.99	2.45	—	—	—	—	—	—
	Imperfect	10.95	9.27	1.54	0.14	—	—	—	—	—
	Well	71.43	18.16	28.28	12.26	5.72	2.97	1.50	2.54	—
O'Brien	All classes	100.0	30.8	61.0	4.0	0.8	0.1	0.6	1.0	1.7
368,260	Poor	14.15	13.17	0.98	—	—	—	—	—	—
	Imperfect	24.64	9.27	15.01	0.19	0.17	—	—	—	—
	Well	59.51	8.35	44.98	3.79	0.63	0.14	0.64	0.98	—
Osceola	All classes	100.0	38.7	47.8	8.9	1.6	0.7	0.5	0.1	1.7
254,705	Poor	16.70	16.60	0.10	—	—	—	—	—	—
	Imperfect	26.55	16.28	10.15	0.12	—	—	—	—	—
	Well	55.05	5.84	37.54	8.79	1.57	0.70	0.55	0.5	—

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Page	All classes	100.0	21.8	25.5	15.7	29.9	2.1	0.3	0.4	4.3
342,400	Poor	11.13	10.95	0.01	0.07	0.10	---	---	---	---
	Imperfect	25.96	4.22	15.68	0.76	5.25	0.05	---	---	---
	Well	58.60	6.59	9.76	14.91	24.55	2.03	0.33	0.43	---
Palo Alto	All classes	100.0	51.5	34.6	10.9	2.2	0.5	0.2	0.1	---
362,894	Poor	40.14	36.56	3.58	---	---	---	---	---	---
	Imperfect	16.97	7.48	9.47	0.02	---	---	---	---	---
	Well	42.88	7.46	21.53	10.87	2.21	0.53	0.20	0.08	---
Plymouth	All classes	100.0	11.8	31.7	35.0	11.5	3.9	2.7	2.3	1.1
552,344	Poor	8.50	7.67	0.83	---	---	---	---	---	---
	Imperfect	7.50	0.15	6.85	0.34	0.16	---	---	---	---
	Well	82.86	3.96	24.05	34.62	11.32	3.88	2.68	2.35	---
Pocahontas	All classes	100.0	67.0	25.2	4.9	0.8	0.3	0.3	0.3	1.2
371,843	Poor	52.66	52.45	0.21	---	---	---	---	---	---
	Imperfect	20.54	12.74	7.80	---	---	---	---	---	---
	Well	25.57	1.83	17.18	4.89	0.75	0.28	0.33	0.31	---
Polk	All classes	100.0	30.0	34.3	12.0	5.8	3.2	1.5	0.3	12.9
380,154	Poor	18.37	17.37	1.00	---	---	---	---	---	---
	Imperfect	22.13	8.98	11.59	---	0.06	---	1.50	---	---
	Well	46.55	3.64	21.67	12.03	5.72	3.23	---	0.26	---
E. Pottawattamie	All classes	100.0	13.7	33.8	12.6	29.2	5.6	1.5	0.9	2.7
299,520	Poor	7.11	6.51	0.01	0.02	0.43	0.14	---	---	---
	Imperfect	11.61	0.64	10.03	0.68	0.16	0.10	---	---	---
	Well	78.61	6.60	23.77	11.87	28.57	5.41	1.47	.92	---

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
W. Pottawattamie 330,240	All classes	100.0	23.2	23.6	11.2	17.9	10.7	4.1	2.0	7.3
	Poor	4.45	4.45	—	—	—	—	—	—	—
	Imperfect	1.70	1.52	0.18	—	—	—	—	—	—
	Well	86.53	17.25	23.43	11.18	17.90	10.65	4.12	2.00	—
Poweshiek 376,960	All classes	100.0	16.9	27.7	22.0	16.8	9.4	2.9	0.2	4.1
	Poor	8.11	7.35	0.18	0.05	0.40	0.13	—	—	—
	Imperfect	27.66	6.75	13.75	0.12	6.09	0.95	—	—	—
	Well	60.11	2.78	13.73	21.86	10.32	8.34	2.85	0.23	—
Ringgold 344,320	All classes	100.0	5.3	23.3	30.3	24.2	11.5	1.1	0.1	4.3
	Poor	10.22	3.98	3.36	2.68	0.20	—	—	—	—
	Imperfect	52.40	0.58	17.78	24.23	9.81	—	—	—	—
	Well	33.05	0.77	2.15	3.37	14.14	11.54	1.06	0.02	—
Sac 371,032	All classes	100.0	28.6	50.3	13.7	4.1	1.3	0.5	0.6	0.9
	Poor	20.73	19.83	0.90	—	—	—	—	—	—
	Imperfect	16.75	6.55	10.10	0.04	—	—	0.06	—	—
	Well	61.61	2.26	39.27	13.62	4.13	1.27	0.42	0.64	—
Scott 289,920	All classes	100.0	23.3	34.5	17.5	6.2	3.5	4.0	1.5	9.5
	Poor	7.31	7.31	—	—	—	—	—	—	—
	Imperfect	20.01	10.43	9.58	—	—	—	—	—	—
	Well	63.16	5.52	24.89	17.53	6.17	3.51	4.04	1.50	—
Shelby 375,683	All classes	100.0	10.0	30.7	7.8	35.0	11.3	2.3	0.3	2.6
	Poor	2.81	2.76	—	—	0.03	0.02	—	—	—
	Imperfect	22.72	1.38	20.75	0.32	0.17	0.03	0.07	—	—
	Well	71.86	5.87	9.93	7.50	34.75	11.22	2.26	0.33	—

Table 1.   Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Sioux 484,790	All classes	100.0	19.6	49.2	22.2	4.3	0.3	0.1	1.0	3.3
	Poor	7.16	6.41	0.74	0.01	—	—	—	—	—
	Imperfect	11.88	5.43	6.45	—	—	—	—	—	—
	Well	77.73	7.78	41.98	22.21	4.34	0.31	0.07	1.04	—
Story 363,520	All classes	100.0	39.0	38.3	9.4	3.2	2.0	1.6	0.4	6.1
	Poor	38.13	35.06	3.07	—	—	—	—	—	—
	Imperfect	14.46	1.79	12.58	—	—	—	0.09	—	—
	Well	41.36	2.11	22.67	9.40	3.19	1.99	1.56	0.44	—
Tama 460,800	All classes	100.0	43.9	31.3	—	10.2	6.3	5.6	—	2.7
	Por	5.29	5.29	—	—	—	—	—	—	—
	Imperfect	6.53	5.93	0.35	—	0.25	—	—	—	—
	Well	85.56	32.64	30.96	—	10.00	6.31	5.65	—	—
Taylor 337,919	All classes	100.0	21.6	22.5	22.7	27.2	2.1	0.7	0.3	2.9
	Poor	19.58	9.22	0.65	9.35	0.36	—	—	—	—
	Imperfect	12.82	10.04	0.51	2.27	—	—	—	—	—
	Well	64.70	2.35	21.33	11.06	26.85	2.08	0.72	0.31	—
Union 272,640	All classes	100.0	12.1	26.0	25.9	19.8	7.4	2.9	1.1	4.8
	Poor	10.41	5.80	4.31	0.30	—	—	—	—	—
	Imperfect	19.55	2.88	11.51	5.10	—	0.06	—	—	—
	Well	65.23	3.36	10.19	20.53	19.79	7.32	2.91	1.13	—
Van Buren 313,597	All classes	100.0	17.5	16.2	18.4	12.3	10.5	16.0	6.2	2.9
	Poor	14.01	13.04	0.96	0.01	—	—	—	—	—
	Imperfect	38.74	0.28	14.37	17.08	6.99	0.02	—	—	—
	Well	44.34	4.19	0.91	1.26	5.34	10.45	15.98	6.21	—

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Wapello 280,327	All classes	100.0	25.4	27.4	20.8	10.6	6.7	3.8	3.3	2.0
	Poor	17.09	14.26	2.83	—	—	—	—	—	—
	Imperfect	36.09	1.17	16.03	16.33	2.56	—	—	—	—
	Well	44.81	9.96	8.54	4.46	8.02	6.71	3.76	3.34	—
Warren 364,820	All classes	100.0	18.6	28.0	23.9	15.2	8.2	5.3	0.5	0.3
	Poor	18.33	13.13	5.20	—	—	—	—	—	—
	Imperfect	21.84	4.03	10.56	7.07	0.13	0.05	—	—	—
	Well	59.46	1.44	12.20	16.86	15.05	8.16	5.28	0.47	—
Washington 363,493	All classes	100.0	30.7	27.7	21.9	14.8	3.2	0.9	0.8	—
	Poor	24.49	24.23	0.24	0.02	—	—	—	—	—
	Imperfect	6.64	1.01	5.59	0.04	—	—	—	—	—
	Well	68.88	5.47	21.85	21.84	14.76	3.25	0.93	0.78	—
Wayne 340,477	All classes	100.0	11.3	27.7	29.2	18.3	10.5	0.5	0.1	2.5
	Poor	15.17	10.69	4.27	0.21	—	—	—	—	—
	Imperfect	30.06	—	3.81	17.83	8.42	—	—	—	—
	Well	52.36	0.58	19.66	11.20	9.86	10.49	0.54	0.03	—
Webster 459,519	All classes	100.0	47.4	41.5	2.9	0.7	0.7	0.7	2.7	3.4
	Poor	43.39	40.24	3.10	—	0.05	—	—	—	—
	Imperfect	24.60	3.08	21.46	0.06	—	—	—	—	—
	Well	28.61	4.13	16.91	2.80	0.69	0.67	0.74	2.67	—
Winnebago 257,280	All classes	100.0	43.9	33.1	16.1	5.1	1.7	0.1	0.1	—
	Poor	45.64	39.93	5.71	—	—	—	—	—	—
	Imperfect	15.67	3.65	11.98	0.04	—	—	—	—	—
	Well	38.69	0.28	15.44	16.04	5.12	1.68	0.09	0.04	—

Table 1. Continued

County and Total Acres in County	Natural Drainage	Percent Totals	% of County in Respective Slope Classes							Excluded Area
			0-1%	2-4%	5-8%	9-13%	14-17%	18-24%	25+%	
Wineshiek 440,284	All classes	100.0	5.6	27.9	26.4	20.6	7.8	5.1	6.5	0.1
	Poor	6.46	2.33	4.07	0.06	—	—	—	—	—
	Imperfect	8.37	1.97	6.02	0.38	—	—	—	—	—
	Well	85.12	1.35	17.84	25.96	20.61	7.81	5.19	6.45	—
Woodbury 561,291	All classes	100.0	28.1	10.2	18.1	20.8	13.3	3.2	1.4	4.9
	Poor	10.27	10.27	—	—	—	—	—	—	—
	Imperfect	5.39	3.44	1.35	0.60	—	—	—	—	—
	Well	79.48	14.40	8.83	17.49	20.82	13.29	3.22	1.43	—
Worth 256,640	All classes	100.0	64.0	23.5	5.6	1.7	1.3	0.1	0.1	3.8
	Poor	41.67	41.34	0.33	—	—	—	—	—	—
	Imperfect	19.73	15.09	4.57	0.07	—	—	—	—	—
	Well	34.83	7.59	18.65	5.50	1.65	1.26	0.14	0.04	—
Wright 369,280	All classes	100.0	55.6	31.4	5.8	1.6	0.9	0.2	0.1	4.4
	Poor	51.65	50.60	1.05	—	—	—	—	—	—
	Imperfect	20.28	2.30	17.89	0.09	—	—	—	—	—
	Well	23.76	2.72	12.46	5.73	1.64	0.92	0.21	0.08	—

are 3 or 4, then chroma are typically 1 or less. Exceptions occur, however, and then observational experience and other morphological features of the soil are used. For example, in soils as the alluvial Wabash series (Oschwald et al. 1965), the subsoil color is black to very dark gray and obscures the olive gray colors diagnostic of poor drainage. Then the combination of 0 to 1 chroma and clay textures in the surface and subsoil layers, as well as the commonly observed water saturation of the subsoil, were used to place the Wabash series in the poorly drained drainage class.

The soils identified as being imperfectly drained generally have mottled brown and gray or partly gleyed subsoil horizons. Mottled subsoil horizons have Munsell hues of 10YR to 5Y with values between 4 and 7 and chroma of 2 or higher. If chroma are between 3 and 6, then mottles of 2 chroma or less are present. High and low chroma colors (yellow and brown to gray) are mixed randomly in the soil matrix. The percentage of yellow and brown to gray color is interpreted to be an indication of the natural soil drainage condition. Soils in Iowa having a high percentage of gray colors and a low percentage of brown colors are less well drained than soils having a low percentage of gray colors and a high percentage of brown colors.

Well drained soils in Iowa usually have yellow-brown or brown subsoil horizons.

Exceptions to the use of gray or mottled subsoil color for poor and imperfect drainage, respectively, have been noted by Ruhe et al. (1955) and Dideriksen (1966). They noted that some well drained soils have gray or mottled subsoils. These soils are on sideslopes where geological erosion has exposed the gray or sometimes mottled materials. The gray materials are stratigraphically related to geochemical weathering zones in the parent materials. They are an indicator of drainage before geological erosion. The colors are commonly relict and are not related to the present natural soil drainage.

In general, poorly drained soils must be drained before they will produce high yields of crops such as corn. Drainage improves tillage and harvesting operations as well as rooting depth of crops. When the soil has an internal permeability of moderate or higher, drainage can be improved by placing tile below the frost line. Soils with very slow internal permeability do not drain rapidly enough for tile to function adequately. Examples of the latter soils are the Edina and Haig soils of southern Iowa and the Luton soils of the Missouri River bottom land (Figure 1; Oschwald et al. 1965). Drainage can be improved on these soils by surface ditches or land grading to a ditch or tile inlet.

Imperfectly drained soils on slightly convex slopes are usually
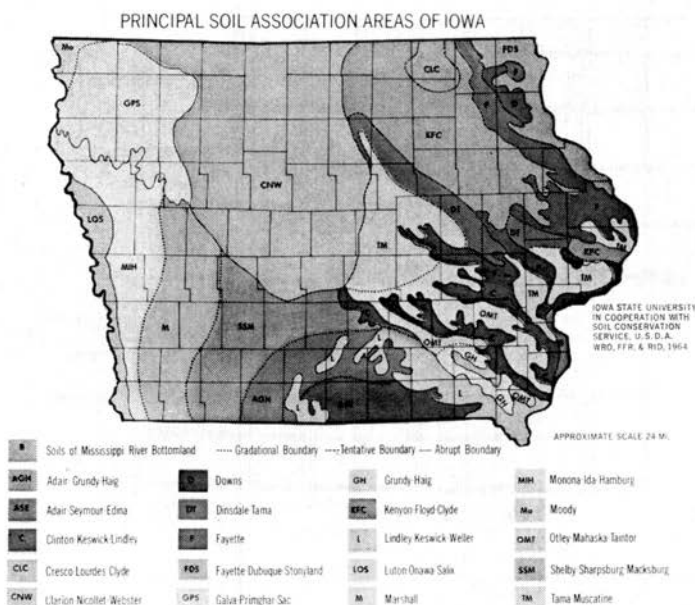
PRINCIPAL SOIL ASSOCIATION AREAS OF IOWA

Figure 1.　Principal Soil Association Areas of Iowa

not tiled in Iowa. However, in the Kenyon-Floyd-Clyde and Cresco-Lourdes-Clyde soil associations in northeastern Iowa (Fig. 1) the imperfectly drained soils are often tiled. In part, it is thought that farmers tile these soils so they may work their fields earlier in the spring and thereby increase the length of the growing season. Farmers with large equipment on large tracts of land want to till and plant the field without interference of a few slightly wet areas.

Well drained soils do not require any improvement in drainage. A more serious problem with the well drained soils is water erosion resulting from rapid runoff.

DISTRIBUTION OF SOILS BY DRAINAGE AND BY SLOPE CLASSES

In Figure 2 a summary is given of the distribution of soils by natural drainage class given in Table 1 for each of the counties in Iowa. The percentage of the soils in each of the three natural drainage classes for each county is proportional to the area of the county covered by the respective drainage class symbol. For example, the percentages of soils in Story County in the respective drainage classes are 38.1% as poorly, 14.5% as imperfectly, and 41.4% as well drained, and are shown as black, horizontal hachuring and unhachured, respectively. By contrast, the soils in Allamakee County are virtually all well drained. Kossuth County has the largest percentage of poorly drained soils of any county, about 56%.
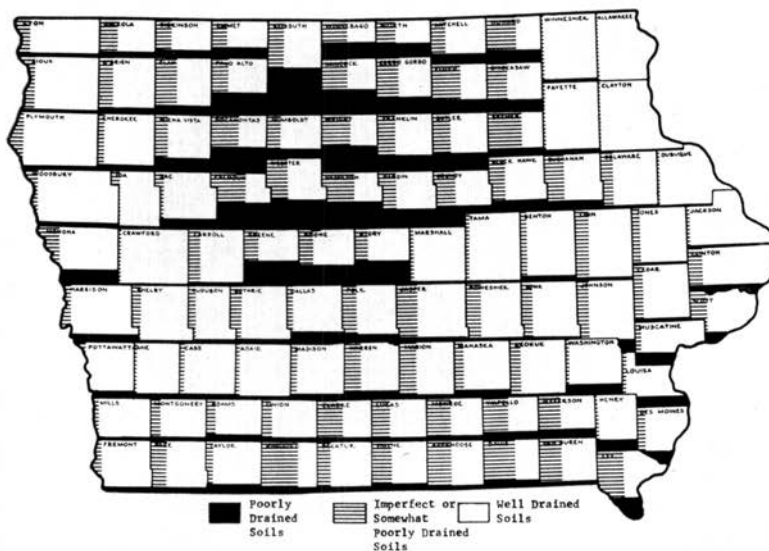
Figure 2.   Distribution of Soils by Drainage Class for Iowa counties

The percentage of the soils in the county occurring in each of the slope classes (0-1%, 2-4%, 5-8%, 9-13%, 14-17%, 18-24%, 25%+, and excluded area) is given in Table 1. These seven slope classes were further grouped into the three slope classes: 0-4.5%, 4.6-8.5%, and greater than 8.6% slope. The percentage of each of the soils in a county within each of these three slope classes is shown in Figure 3. Figures 2 and 3 are correlated; counties having

Figure 3.   Distribution of Soils by Slope Class for Iowa counties

large percentages of well drained soils are the same counties with large percentages of soils having slopes greater than 8.6 percent. Some counties do have some poorly drained soils on steeper slopes. These are mainly in southern and southeastern Iowa where the underlying Kansan till clayey paleosol outcrops on the steep side-slopes.

Figure 3 graphically shows the average slope of individual counties and also of the state. Those counties with relatively low average slope occur in northwestern and north-central Iowa. Soils with the greatest average slope are in northeastern Iowa adjacent to the Mississippi River. The soils in Allamakee County have the following slope: 16.9 percent have slopes less than 4.5%, 17.1 percent have slopes between 4.6 and 8.5%, and 63.7 percent have slopes greater than 8.6%.

USE, MANAGEMENT, AND CONSERVATION CONSIDERATIONS

The purpose of this paper has been to present data on the natural drainage and slope distribution of soils of Iowa counties. Differences among Iowa counties in natural drainage and slopes of soil resources are evident. As a result, different use, management, and conservation considerations are to be expected in different counties. For example, Allamakee County has mostly well-drained, quite sloping soils, and water erosion control practices are an important conservation need.

In constrast, most north-central Iowa counties have a preponderance of poorly drained, level soils (Figs. 2, 3). On such soils, farming practices include tile and surface drainage. Fall plowing is also a common practice to aid in winter freezing and thawing to form a more granular structure for the seedbed and to aid drying of the surface soil for earlier planting of crops. Recent technology has resulted in almost continuous row crops with extensive use of nitrogen fertilizer. Wind erosion has been most common in soil areas that use fall plowing practices. This problem and some suggestions for its amelioration have been discussed by Moldenhauer and Duncan (1969).

Natural soil drainage also affects non-farming uses of soils. For example, poorly and imperfectly drained soils have seasonally water-saturated subsoils. This wetness severely limits their use for solid waste disposal (land fill) as there would be a potential hazard to contamination of the ground water. They are also severely limited for septic field use as the effluent could not discharge into a wet soil, and there would be a hazard of contamination of the water supplies recharged through water-saturated subsoils. Though most well drained soils of Iowa have fewer limitations for these uses, there are exceptions. For example, well drained soils with

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porous limestone present in the subsoil may also have severe limita-
tion because of potential contamination of water. For this kind of
information, soil type must be considered. Soil type was mapped in
the sample soil survey but is not presented in this paper.

Detailed County Soil Surveys

For more precise and county-wide information on soil, slope,
and drainage than provided by the sample soil survey, detailed
county soil survey reports should be consulted. The county soil
reports also include soil type information. The more recent county
soil survey reports, as that of Winneshiek County (Kittleson and
Dideriksen, 1968), also include a wide range of interpretations on
the suitability for and limitations of the different soils for various
uses. The detailed county soil surveys are made cooperatively by
the Soil Conservation Service of the U. S. Department of Agricul-
ture and the Iowa Agriculture and Home Economics Experiment
Station of Iowa State University. Detailed county soil surveys are
made on aerial photograph base maps usually of 4-inch-to-the-mile
scale. Publication is usually also on this or a slightly smaller scale.
Sixteen detailed county soil surveys have been published, twelve
are in one stage or another of publication, and soil mapping is in
progress in an additional twenty-two counties. County Extension
and County Soil Conservation District Offices, or the Publications
Distribution Office of Iowa State University, Ames, may be con-
tacted for information on availability of detailed county soil sur-
veys.

Summary

The distribution of soils by natural drainage class and by slope
groups is given. Problems associated with drainage class and slope
class are quantified for individual counties in Iowa. Various in-
dividuals and groups may find this information helpful in their
programs. This information can be especially useful to individuals
responsible for broad resource planning. County Extension Coun-
cils, Soil Conservation Districts, county and regional planning
groups, and county supervisors are examples of individuals who may
be able to use the individual county data in their program planning
and decision making sessions.

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