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A Comparison of Iowa's Original Corn Suitability Rating Index to the new Corn Suitability Rating 2

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Concepts to create crop productivity indices for Iowa's soils were first conceived during the 1940s. In 1971 Dr. Thomas Fenton and several of his colleagues published *Productivity Levels of Some Soils - Special Report No. 66* (Fenton et al., 1971). This publication established the Corn Suitability Rating (CSR) as the productivity index for Iowa's soils. Creation of the CSR provided county assessors an unbiased means to assess farmland. In 1977 legislation measures were passed clarifying, while expanding, the role for how assessors could use the CSR and net earning capacity on land valuation.

The CSR for all soil map unit symbols (MUS) within Iowa is based on a soil's potential for row-crop production. A CSR rating for each MUS is calculated using it's inherent soil properties, average precipitation for where it is located within the state, and the frequency it's in row-crop production (Equation 1). The rating also assumes a MUS is adequately managed, artificially drained where required, if located on lower landscapes is not frequently flooded, and there is no land leveling or terracing. Corn suitability ratings can range from 100 for MUSs that have no physical limitations for continuous row cropping to as low as 5 for MUSs with severe limitations for row cropping.

Equation 1

CSR = S - E - B ± W - C - D - SG - P - DSM - PM - MP (modified from Fenton et al., 1971)

S	= slope	**SG**	= sandy or gravelly soils
E	= erosion	**P**	= precipitation factors
B	= biosequence	**DSM**	= deposition and special soil modifiers
W	= wetness	**PM**	= parent material
C	= calcareous soils	**MP**	= muck and peaty soils
D	= depth phase		

Soil property and CSR data were recorded and stored using the Soil Conservation Service (SCS), now the National Resources Conservation Service (NRCS), form SOILS-5, Map Unit Use File (MUUF), and Iowa CONS-9 making it difficult to easily access all available soil data at once. In 1984 Dr. Gerald Miller compiled all soil data pertaining to Iowa into a single computer database called the Iowa Soil Properties and Interpretations Database (ISPAID). Creation of ISPAID improved the availability and distribution of soil properties and interpretations data for all Iowa soils. ISPAID became widely used by researchers, teachers, land evaluators, producers, and within extension educational programs.

Since the establishment of the CSR in 1971, the science for calculating a MUS's CSR became more robust as the knowledge base of soil properties was significantly enhanced and expanded. Another change since the establishment of the CSR in 1971 was the soil classification system in use at that time was replaced with the current classification system. Currently, there are 507 soil series actively being mapped in Iowa. That is 150 additional soil series that were not recognized as soils in Iowa when the CSR was first established in 1971.

As knowledge of soil properties improved, in addition to, new MUSs being mapped in Iowa, the CSR equation became a more expert driven calculation. In 2013, Burras et al. (2015) introduced an updated equation for calculating CSR values called the Corn Suitability Rating 2 (CSR2) (Equation 2). The CSR2 equation provided an index with ratings comparable to CSR, but with more consistency and transparency. Unlike the CSR equation, expert knowledge for a MUS was not required to calculate a CSR2 value. The CSR2 equation established clearer parameters anyone interested in calculating a CSR2 value could understand and use.

Equation 2

CSR2 = S - M - W - F - D ± EJ (Burras et al., 2015)

S	= taxonomic subgroup class of the series of the soil map unit (MU)
M	= family particle size class
W	= available water holding capacity (AWC) of the series
F	= field condition of a particular MU
	• Slope
	• Flooding
	• Ponding
	• Erosion class
	• Topsoil thickness
D	= soil depth and tolerable rate of soil erosion
EJ	= expert judgement correction factor
	• Normally used with parent materials with very high bulk density and/or are usually clayey or sandy

Similar to the original CSR, the CSR2 assumes a MUS is adequately managed, artificially drained where required, and there is no land leveling or terracing. A major difference between the CSR and the CSR2 is the CSR included a rainfall correction factor where the CSR2 does not.

When the original CSR was created the mean precipitation data used in the equation was for the 30-year period between 1931-1960. During this period precipitation was significantly lower in west, southwest, and northwest of central Iowa compared to the remaining areas of the state (Figure 1). This is why a precipitation factor was included with the original CSR equation. In comparison, a review of more recent mean precipitation data for the 30-year period of 1981-2010 documented an increase in precipitation by approximately five to seven inches in north-central, northwest, and western Iowa (Figure 2). This increase in mean precipitation for the 30-year period of 1981-2010 compared to the 30-year period of 1931-1960 was enough that precipitation was no longer an associated limiting factor toward row-crop production within any region of Iowa, and was thus the reason a precipitation correction factor was not included in the CSR2 equation.

Figure 1
1931-1960 Yearly Average Precipitation

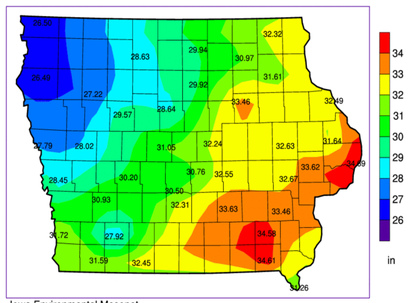
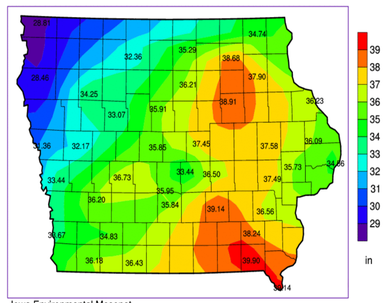


Figure 2
1981-2010 Yearly Average Precipitation



Generally, CSR2 values for MUS are proportional to CSR values. Exceptions to this are in north-central and western Iowa where CSR2 values are generally higher (Figure 3 and Table 1) compared to CSR values (Figure 4 and Table 1). These increases in CSR2 values are associated to the removal of the precipitation factor from the CSR2 equation; whereas the CSR equation deducted points, primarily in north-central and western Iowa, to address the impact lower precipitation may have had on row-crop production. In regions of the state where precipitation was not previously limiting, there was little change between MUS CSR and CSR2 values (Table 1).

Figure 3 - Iowa CSR2 Weighted Mean by County

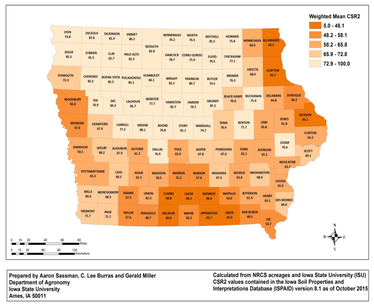


Figure 4 - Iowa CSR Weighted Mean by County

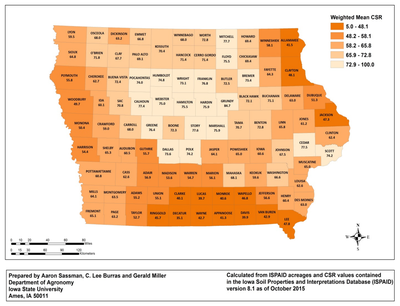


Table 1 - Comparison between the CSR and CSR2 for various soils across Iowa.†

					Suitability Rating		Estimated Corn Yield	
Soil Series	Map Unit Symbol	County	Mapped Within County	Land Capability Class	CSR	CSR2	CSR	CSR2
			%				bu/ac	
Galva	310B	O'Brien	28	2E	70	95	192	232
Ida	1E3	Harrison	9	4E	30	11	128	98
Monona	10D2	Crawford	2	3E	53	61	165	178
Marshall	9D2	Audubon	14	3E	58	61	173	178
Sharpsburg	370B	Adair	9	2E	87	91	219	226
Shelby	24D2	Taylor	4	3E	48	55	157	168
Clarion	138B	Kossuth	12	2E	77	91	203	226
Nicollet	55	Story	14	1	94	96	230	234
Webster	107	Franklin	5	2W	84	90	214	224
Tama	120B	Marshall	13	2E	95	95	232	232
Downs	162D2	Jasper	4	3E	61	53	178	165
Kenyon	83B	Chickasaw	7	2E	84	91	214	226
Clyde	84	Bremer	10	2W	76	90	202	224
Fayette	163D2	Dubuque	12	3E	58	53	173	165
Otley	281B	Keokuk	5	2E	90	91	224	226

† Data from the Iowa Soil Properties and Interpretations Database (ISPAID) version 8.1

In addition to land assessment the CSR and CSR2 has also been used to estimate corn yields for MUSs across Iowa. Previous corn yield estimates for MUSs used a linear regression model that compared CSR values to annual county and state yield reports published by the National Agriculture Statistical Service (NASS) normalized across five-years (Fenton et al., 1971 and Miller, 2012). This linear regression model was also used for the CSR2 estimated corn yields (Equation 3). Equation 3 estimates that a MUS with a CSR or CSR2 value of 100 can achieve a corn yield of 240 bushels per acre (bu/ac) under a high level of production management.

Equation 3

Estimated Corn Yield = (1.6 * CSR or CSR2 value) + 80
1.6 = slope of regression
CSR or CSR2 value = calculated using Equation 1 for CSR or Equation 2 for CSR2
80 = constant

Similar to the comparison between CSR and CSR2 values, estimated corn yields in north-central and western Iowa increased when CSR2 values were used (Table 1 and Figure 5) compared to when CSR values were used (Table 1 and Figure 6). As explained previously, the removal of the precipitation factor from the CSR2 equation can explain this change since estimated corn yields are directly related to the CSR or CSR2 value. It needs to be noted that these are estimated, not expected yields. Corn yields are greatly influenced by variations in annual weather patterns, advancements in equipment technology and plant breeding, and method of production management used. In addition, corn yields can vary within any individual MUS.

Figure 5 - Estimated Corn Yield Weighted Mean by County using Iowa CSR2

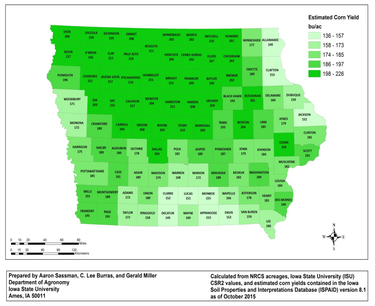
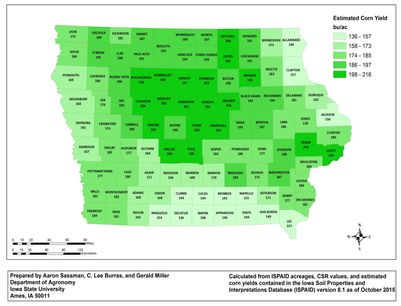


Figure 6 - Estimated Corn Yield Weighted Mean by County using Iowa CSR



After comparing the Iowa CSR index to the new Iowa CSR2 index the removal of the precipitation factor from the CSR2 equation has increased soil productivity values and estimated corn yields in north-central and western Iowa while other areas of the state were minimally affected. Soil productivity indices need to be routinely reviewed and updated in order to provide a productivity rating that reflects any gains in soil knowledge or anthropogenic changes that can influence a soil's productivity whether those changes are positive or negative. As with productivity indices, estimated corn yields need to be reviewed often. Changes in crop production technologies and management techniques have a great influence on overall corn yields. Providing the wrong CSR2 value or corn yield estimates can influence a producer's decision making process on how a MUS should be managed.

References

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