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A Very Early Estimate of Corn Production From the 18 Leading Corn States

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Introduction

Starting in June, the USDA collects weekly crop conditions from all the leading corn states. Some states have earlier estimates though. These estimates continue until harvest. The crop is rated as either: very poor, poor, fair, good, or excellent. These estimates are reported on Monday afternoons based on reports collected from the prior weekend. With only a few days between reporting and publication, this is some of the most current data available from the USDA. There are crop condition reports going back to 1986.

These weekly crop reports have been used with varying degrees of success to predict both state crop yields and harvested acres. Ibendahl (2022 and 2023) has used the data to predict state and national wheat, corn, and soybean yields, acres, and total grain production. As might be expected, the accuracy of the predictions increases as the growing season progresses. The first few weeks of crop reports have very low predictive power, and this report is no different. Irwin and Good (2017), using a different model of crop conditions, reported similar predictive accuracy early in the growing season.

Even though the predictive power of the crop report model is low at this point, this article demonstrates how the model works and provides an estimate of corn yields, harvested acres, and total production from the 18 leading corn states. The model is based on the planted acres in addition to the June 4th crop condition report. The results include the expected corn production from each state as well as the confidence interval for that estimate. To produce an estimate of corn production, both expected yields and harvested acres are estimated. The model presented here is unique as a national corn estimate is based on predicting each state's corn acres and yield per acre from a 30-year timeline of data from a specific week during the year. The individual state estimates are then combined into a national estimate.

Procedure

As described earlier in Ibendahl (2022 and 2023), the Bain and Fortenbery model uses all five of the crop condition values in the construction of an index (CCIndex).

CCIndex = (% acreage Excellent) * 1 +

(% acreage Good) * 0.75 +

(% acreage Fair) * 0.50 +

(% acreage Poor) * 0.25 +

(% acreage Very poor) * 0

Because the crop conditions are mutually exclusive, the sum of the percent of acres across the five categories must total to 100 percent. Thus, possible index values range from 100 (if all the crop acres are excellent) down to 0 (if all the crop acres are very poor). A value of 50 would indicate the average crop condition for the state is in fair condition. The USDA provides data at the state level but not at the crop reporting district level nor at the county level.

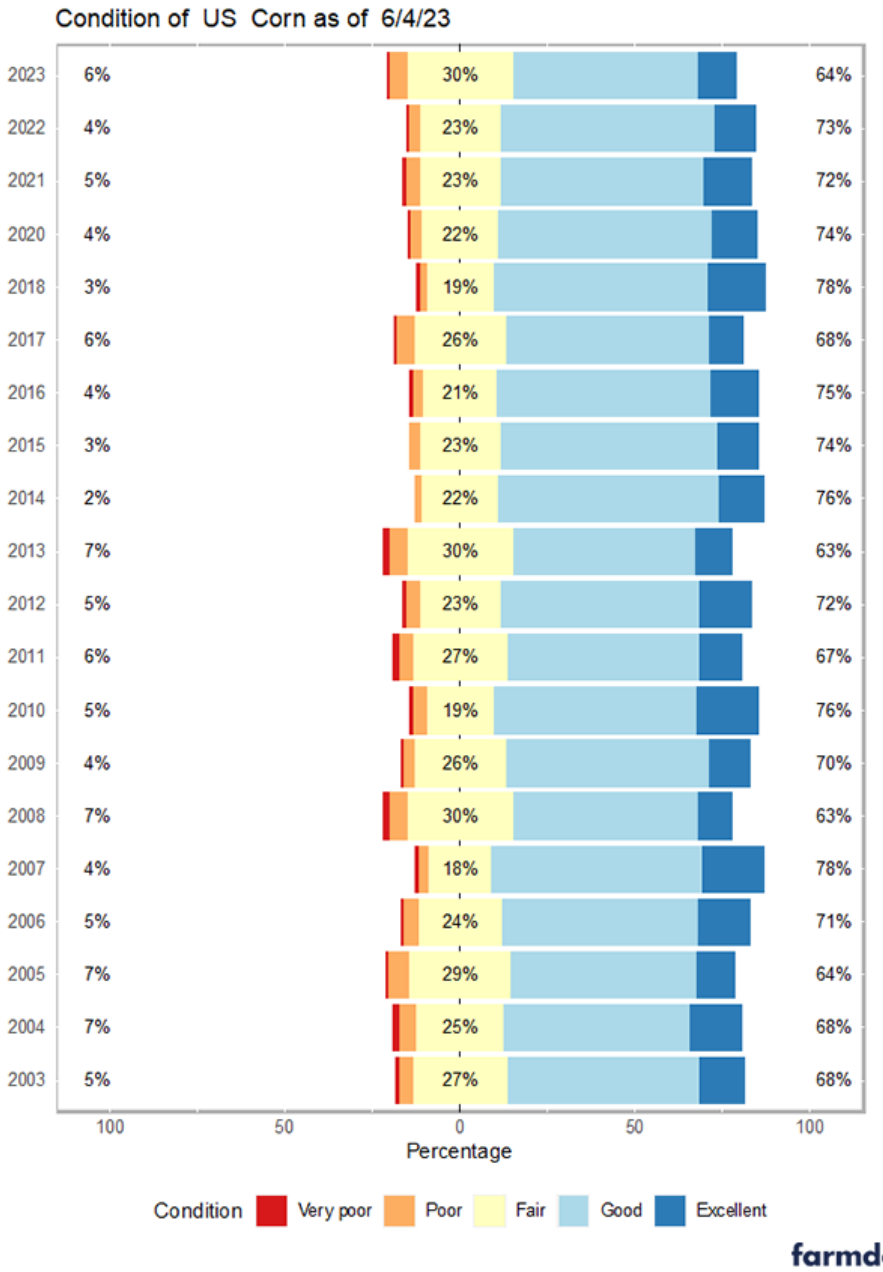
In this analysis, the crop condition report for a specific week is used to construct a CCI index for the last 30 years (the same week from each of the 30 years). The crop conditions from the week of June 4th are used in the model reported here. These CCIndexes are then used in a regression analysis to estimate the deviation from trend line corn yield in each state. Each state is estimated individually and the yield per acre confidence interval for each state is also calculated. Because the yield estimate is based on a specific week, the model must be rerun for each week of the growing season. That is, an analysis of the crop growing conditions next week will produce a different set of parameters than the current week as the CCIndex changes from week to week for both the current and historical years.

To estimate corn production in each state, an estimate is needed of the harvested acres as well. In this analysis, the percentage of corn in the very poor category is used to estimate the percent of corn harvested acres relative to the planted corn acres. At this point, there are no USDA estimates of harvested acres. The harvested acres estimate is also unique to each week as it is also based on the 30 years of crop conditions reports at that week. In future models, this estimate of corn harvested acres will be based on USDA crop reports as they become available. The model does provide a confidence interval for the percent of planted acres that are harvested and these are incorporated into the final estimate of corn production for each state.

Results

Figure 1 is a Likert graph of the corn crop conditions for the last 20 years in the U.S. The Likert graph is centered on the fair category to make comparisons among years easier. The number along the left-hand-side of the figure is the total of the very poor and poor categories while the number along the right-hand-side is the total of the good and excellent categories. The Likert graph shown in Figure 1 indicates that corn over the last 20 years looks remarkably similar the first week of June. This graph indicates part of the reason the model has low predictive ability at this point. Corn, assuming it emerges correctly, tends to look fine initially. It may take a few weeks before any dry soil conditions start to show up in appearance.

Figure 1. Historical Corn Crop Conditions for U.S. Corn – 6/4/23



Tables 1, 2, and 3 show the estimated yield per harvested acre, the estimated harvested acres, and the total production for each of the 18 leading corn states. As mentioned above, the fit of the model in most states is very poor at this point. The model is basically giving a trend line estimate for yield with wide confidence intervals. Similarly, the harvested acre estimate is roughly the mean of the typical harvested acre percentage of the planted acres.

Table 1. Estimated Yield per Harvest Acre for 18 States as of 6/4/23

Corn Yields per Acre by State - 6/4/23

Bushels per harvested acre

State	Last year	2023 prediction			
		Lower CI	Predicted	Upper CI	R squared
Colorado	121.0	131.1	135.5	139.9	0.01
Illinois	214.0	186.1	198.5	210.9	0.02
Indiana	190.0	180.5	187.3	194.1	0.00
Iowa	200.0	200.6	206.3	212.0	0.08
Kansas	115.0	120.4	128.6	136.8	–0.03
Kentucky	156.0	168.1	175.9	183.7	0.06
Michigan	168.0	164.2	169.3	174.3	–0.02
Minnesota	195.0	194.5	200.4	206.3	0.14
Missouri	161.0	144.2	156.5	168.8	0.04
Nebraska	165.0	182.0	188.8	195.6	0.06
North_Carolina	126.0	128.2	135.6	142.9	0.11
North_Dakota	131.0	141.6	146.9	152.3	0.27
Ohio	187.0	176.5	182.8	189.0	0.11
Pennsylvania	140.0	118.9	144.1	169.3	0.00
South_Dakota	132.0	149.1	156.4	163.7	0.05
Tennessee	130.0	158.8	167.2	175.5	0.03
Texas	95.0	130.4	136.6	142.8	0.34
Wisconsin	180.0	174.6	178.9	183.1	0.16

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Table 2. Estimated Harvested Acres for 18 States as of 6/4/23

Total Corn Production by State - 6/4/23

1,000,000 bushels

	State	Last year	2023 prediction Lower CI	Predicted	Upper CI
	Colorado	119	154	165	176
	Illinois	2,268	1,999	2,146	2,295
	Indiana	975	962	1,001	1,040
	Iowa	2,480	2,538	2,627	2,717
	Kansas	511	593	663	737
	Kentucky	211	247	260	273
	Michigan	336	340	354	368
	Minnesota	1,461	1,485	1,546	1,609
	Missouri	502	465	512	560
	Nebraska	1,455	1,562	1,654	1,747
	North_Carolina	99	111	119	127
	North_Dakota	350	452	490	530
	Ohio	595	568	590	613
	Pennsylvania	118	102	130	161
	South_Dakota	661	756	815	875
	Tennessee	103	138	147	155
	Texas	153	231	248	266
	Wisconsin	545	533	554	576
sum	—	12,941	13,238	14,023	14,827

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Table 3. Estimated Corn Production for 18 States as of 6/4/23

Corn Harvested Acres by State - 6/4/23

1,000 acres

	State	Last year	Planted acres	2023 harvest estimate Lower CI	Predicted	Upper CI	R squared
	Colorado	980	1,400	1,178	1,217	1,256	0.28
	Illinois	10,600	11,000	10,743	10,814	10,885	−0.04
	Indiana	5,130	5,500	5,331	5,345	5,358	0.00
	Iowa	12,400	13,100	12,650	12,732	12,815	0.04
	Kansas	4,440	5,600	4,927	5,158	5,388	−0.03
	Kentucky	1,350	1,600	1,471	1,480	1,488	0.00
	Michigan	2,000	2,400	2,074	2,092	2,110	−0.04
	Minnesota	7,490	8,350	7,634	7,717	7,799	0.60
	Missouri	3,120	3,450	3,222	3,270	3,317	−0.02
	Nebraska	8,820	9,500	8,583	8,759	8,935	0.39
	North_Carolina	785	960	868	878	888	0.04
	North_Dakota	2,670	3,750	3,196	3,337	3,479	−0.01
	Ohio	3,180	3,450	3,218	3,230	3,242	0.02
	Pennsylvania	840	1,310	858	906	953	−0.03
	South_Dakota	5,010	5,900	5,070	5,208	5,346	0.02
	Tennessee	795	960	869	877	885	0.27
	Texas	1,610	2,050	1,773	1,818	1,864	0.31
	Wisconsin	3,030	3,950	3,053	3,099	3,145	0.33
sum	—	74,250	84,230	76,717	77,937	79,156	—

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Table 4 projects the 18 leading corn states acres and production into a national total for acres and production. Because the yield per acre from the individual states can't be summed together, the shown yield per acre is calculated from the total production divided by the total harvested acres. As the table indicates, total production is expected to be 14.878 billion bushels with a range from 14.044 to 15.730 billion bushels. Harvest acres are expected to be 83.140 million acres with a range from 81.839 to 84.441 million acres. Table 4 also lists the NASS planted acres.

Table 4. National Projections for Corn Acres, Yields, and Total Production

		Model est	NASS planted est
Acres (1,000 ac)	Low	81,839	
	Expected	83,140	91,996
	High	84,441	
Yield/ac	Low	171.6	
	Expected	178.9	
	High	186.3	
Production (1,000,000 bu)	Low	14,044	
	Expected	14,878	
	High	15,730	

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Important

This is the earliest a national estimate can be calculated using the USDA crop condition reports. Because it is so early, the model accuracy is very low. Readers should expect changes to the estimates as the season progresses and perhaps even significant changes depending on the amount of rain received over the growing season. Also, as noted by Irwin and Good, the earliest estimates probably tend to overestimate yields. Readers should interpret these results as production that could occur during a normal growing season.

References

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