Estimates of Soybean Production and Yields Based on 6/30/2024 Crop Conditions

Gregg Ibendahl

Department of Agricultural Economics
Kansas State University

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This article estimates soybean yields for the 18 leading soybean states and then calculates total soybean production and average national soybean yield using the recently released NASS crop acre estimates. Based on the 6/30/24 crop condition report (week 26), total soybean production is estimated to be 4.4 billion bushels with a range from 4.3 billion to 4.6 billion bushels. The national soybean yield is estimated to be 51.9 bu/ac with a range from 50.1 to 53.7 bu/ac.

Introduction

Starting in June, the USDA collects weekly crop conditions from all the leading soybean 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, especially for the northern states, it is improving. This article demonstrates how the model works and provides an estimate of soybean yields, harvested acres, and total production from the 18 leading soybean states. This model is based on the NASS estimate of harvested acres from June 28th USDA-NASS Acreage Report. Soybean yields are estimated from the June 30th USDA-NASS Crop Condition Report following the procedure described below. The results include the expected soybean production from each state as well as the confidence interval for that estimate. To produce an estimate of soybean production, the estimated yield

for each state is multiplied by the NASS estimate of state harvested acres. The model presented here is unique as a national soybean estimate is based on predicting each state's soybean 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 30th are used in the model reported here (week 26). These CCIndexes are then used in a regression analysis to estimate the deviation from trend line soybean 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.
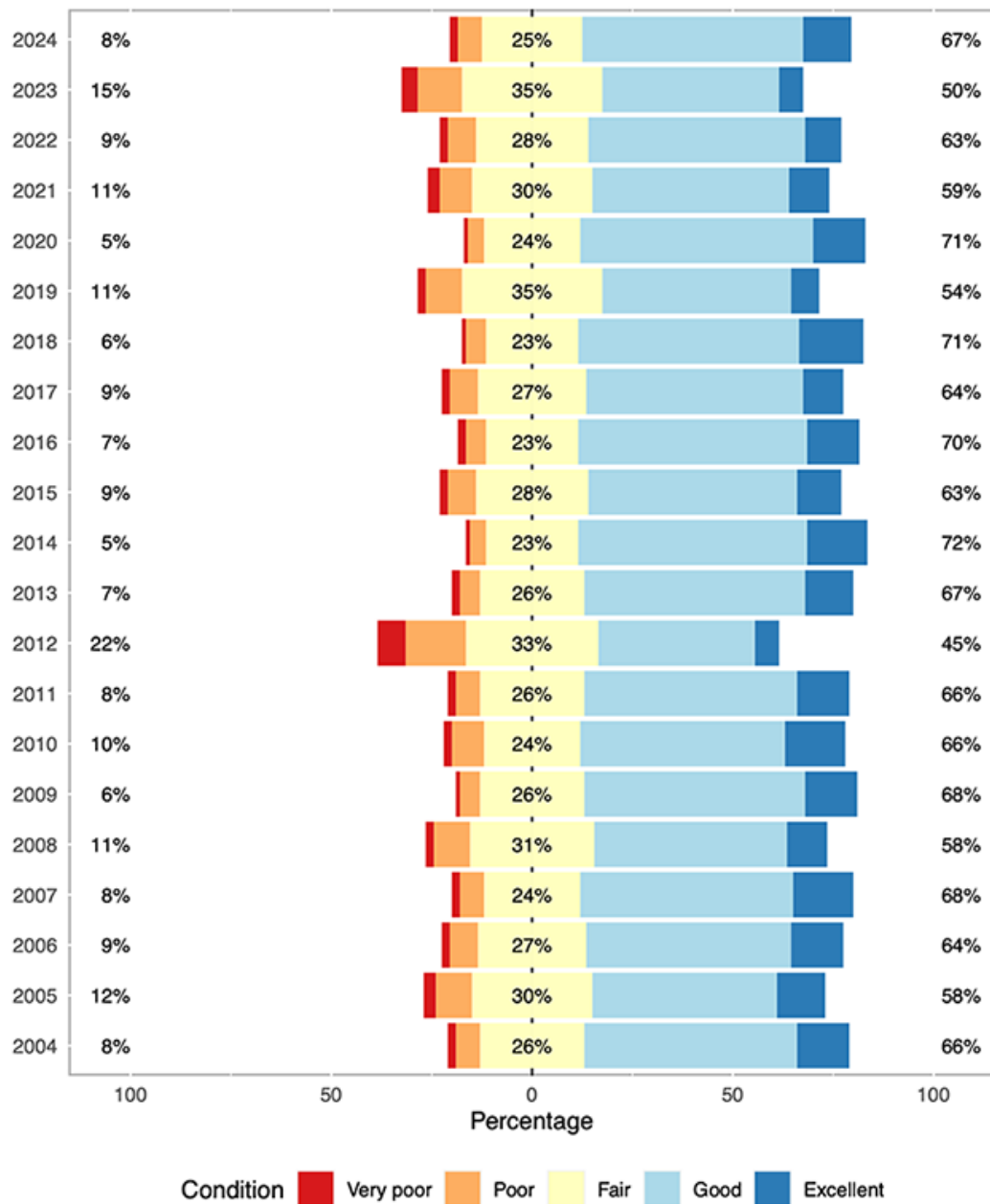
Results

Figure 1 is a Likert graph of the soybean 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 soybean over the last 20 years looks remarkably similar the last week of June. Soybeans so far in 2024 looks a little better than last year and almost identical to 2022.

Figures 2, 3, and 4 show the estimated yield per harvested acre, the estimated harvested acres, and the total production for each of the 18 leading soybean states. As mentioned above, the fit of the model in most states is still improving at this point. The model is basically giving a trend line estimate for yield with wide confidence intervals. The harvested acre estimate comes directly from the USDA-NASS estimate from the June 28, 2024 *Acreage* report.

Figure 5 projects a national yield per acre for each week with a crop condition report. 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. Total U.S. soybean production is calculated by adjusting the production from the 18 leading soybean states upward based on the historic relationship between U.S. production and the production from the 18 leading soybean states. As calculated, total U.S. soybean production is estimated to be 4.42 billion bushels with a range from 4.27 billion to 4.58 billion bushels. The national soybean yield is estimated to be 51.9 bu/ac with a range from 50.1 to 53.7 bu/ac.

Figure 1. Likert Graph of Soybean Crop Condition

Condition of US Soybeans as of 6/30/24

Year	Poor (left %)	Fair %	Good+Excellent (right %)
2024	8%	25%	67%
2023	15%	35%	50%
2022	9%	28%	63%
2021	11%	30%	59%
2020	5%	24%	71%
2019	11%	35%	54%
2018	6%	23%	71%
2017	9%	27%	64%
2016	7%	23%	70%
2015	9%	28%	63%
2014	5%	23%	72%
2013	7%	26%	67%
2012	22%	33%	45%
2011	8%	26%	66%
2010	10%	24%	66%
2009	6%	26%	68%
2008	11%	31%	58%
2007	8%	24%	68%
2006	9%	27%	64%
2005	12%	30%	58%
2004	8%	26%	66%

Percentage

Condition: Very poor, Poor, Fair, Good, Excellent

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Figure 2. Estimated Yields per Acre for 18 Leading Soybean States

Soybean Yields per Acre by State - 6/30/24

Bushels per harvested acre

| State | Last year | 2024 prediction | | | R squared |
		Lower CI	Predicted	Upper CI	
Arkansas	54.0	54.4	56.1	57.7	0.16
Illinois	63.0	60.9	62.3	63.7	0.12
Indiana	61.0	58.2	59.5	60.9	0.21
Iowa	58.0	56.7	58.3	59.9	0.01
Kansas	26.0	36.3	39.2	42.1	0.06
Kentucky	55.0	50.9	53.6	56.3	−0.02
Louisiana	40.0	53.3	56.5	59.6	0.11
Michigan	46.0	47.4	49.0	50.5	0.02
Minnesota	48.0	47.1	48.5	49.9	0.04
Mississippi	56.0	56.5	58.0	59.6	0.08
Missouri	48.0	48.4	51.0	53.6	0.17
Nebraska	51.5	61.4	63.0	64.7	0.52
North_Carolina	38.5	25.7	30.3	34.9	0.33
North_Dakota	35.5	31.6	33.4	35.1	0.06
Ohio	58.0	55.6	57.1	58.6	0.12
South_Dakota	44.0	43.1	44.6	46.2	−0.01
Tennessee	51.0	47.8	50.0	52.2	0.09
Wisconsin	51.0	45.1	47.9	50.7	0.13

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Figure 3. Estimated NASS Harvested Acres for 18 Leading Soybean States

Soybean Harvested Acres by State – 6/23/24
1,000 acres

| State	Last year	Planted acres	2024 harvest estimate NASS est
Arkansas	2,950	3,050	3,020
Illinois	10,300	10,700	10,650
Indiana	5,480	5,750	5,730
Iowa	9,880	9,900	9,820
Kansas	4,030	4,550	4,500
Kentucky	1,820	2,050	2,040
Louisiana	980	1,170	1,130
Michigan	2,030	2,250	2,240
Minnesota	7,280	7,600	7,530
Mississippi	2,130	2,250	2,210
Missouri	5,520	5,600	5,530
Nebraska	5,180	5,300	5,250
North_Carolina	1,630	1,550	1,540
North_Dakota	6,160	6,800	6,750
Ohio	4,730	4,850	4,830
South_Dakota	5,070	5,100	5,050
Tennessee	1,570	1,700	1,670
Wisconsin	2,060	2,150	2,120
sum —	78,800	82,320	81,610

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Figure 4. Estimated Soybean Production for 18 Leading Soybean States

Total Soybean Production by State – 6/30/24
1,000,000 bushels

	State	Last year	2024 prediction Lower CI	Predicted	Upper CI
	Arkansas	159	164	169	174
	Illinois	649	649	663	678
	Indiana	334	333	341	349
	Iowa	573	557	573	589
	Kansas	105	163	176	189
	Kentucky	100	104	109	115
	Louisiana	39	60	64	67
	Michigan	93	106	110	113
	Minnesota	349	355	365	376
	Mississippi	119	125	128	132
	Missouri	265	268	282	296
	Nebraska	267	322	331	340
	North_Carolina	63	40	47	54
	North_Dakota	219	213	225	237
	Ohio	274	269	276	283
	South_Dakota	223	217	225	234
	Tennessee	80	80	84	87
	Wisconsin	105	96	102	107
sum	—	4,017	4,121	4,271	4,420

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Figure 5. Estimated National Soybean Yield per Acre
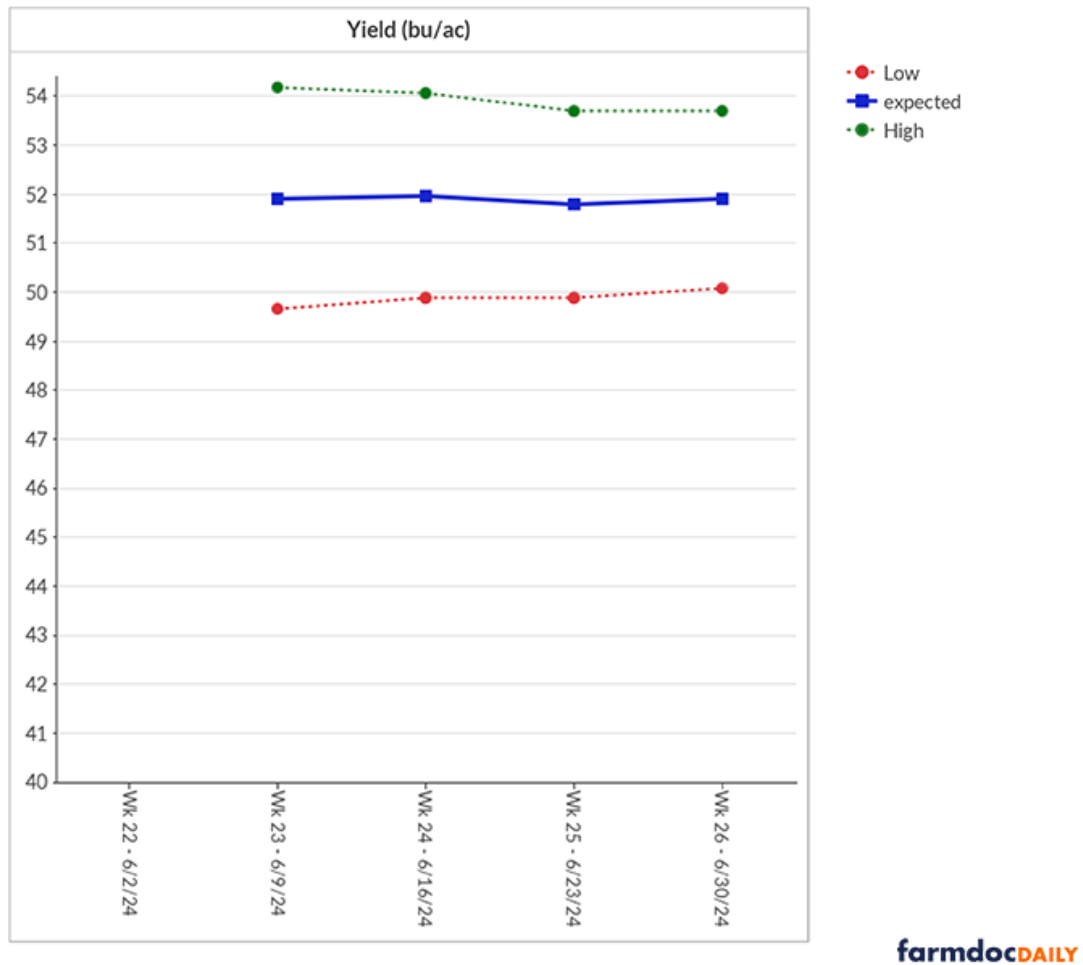
Concluding Thoughts

It is still early in the growing season. 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.

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