The Economic Impact of U.S. Soybeans and End Products on the U.S. Economy — 2023 Update

Report for:

United Soybean Board & National Oilseed Processors Association

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The Economic Impact of U.S. Soybeans and End Products on the U.S. Economy – 2023 Update

Introduction

The United Soybean Board (USB) and the National Oilseed Processors Association (NOPA) commissioned LMC International (LMC) to undertake research and analysis to quantify the benefit of soybeans to the American economy in terms of:

1. **Economic impact**
2. **Number of people dependent on the sector**
3. **Wages**

and at different levels:

1. **National**
2. **State**
3. **Congressional district**

This study provides the results of that independent analysis. This report updates the original study undertaken in 2018/19.

The value chain

We focus specifically on the **production, distribution and use of soybeans and soybean products**, spanning the value chain: from soybean farming and processing to the delivery of soy products to end users or ports of export. To this we add the economic benefit to the livestock sector of using soybean meal. We also include limited coverage of the economic impact of soybean oil in food production — focusing on edible products that are 100% or nearly 100% soy oil, namely bottled oil, margarine and shortening. The report estimates the value added in soybean production and at each subsequent step in the value chain.

The results capture:

1. The ***direct*** benefit from these stages.
2. The ***indirect*** benefit from associated industries and market activities.
3. The ***induced*** benefit from household spending of the income earned from the soy sector.

Research approach

The objective is to develop an up-to-date assessment, using:

- Official, citable data as much as possible.
- The latest data spanning the 2017/18-2021/22 crop years. These extend the estimates from the previous report, which covered the years to 2016/17.

- Interviews with industry participants.
- Best practice in estimating economic benefits.

To perform the analysis, we begin by calculating the ***Direct Impact*** — the value added, jobs and wages directly attributable to the soybean sector. The ***Indirect*** and ***Induced impact*** is then quantified using economic multipliers derived by the U.S. Department of Commerce's Bureau of Economic Analysis (BEA).

The Total Impact represents the sum of the calculated direct impact plus the indirect and induced multiplier effects.

It is worth noting that BEA's latest multipliers, which were utilized for this study, are in some cases lower than those utilized in the previous 2018/19 study. For certain stages in the value chain, this results in a decrease in total employment, economic and wage effects compared to findings from the previous study. However, the multipliers do not affect the direct impact results have mostly increased as prices and volumes have risen over the past couple of years[1].

The big picture: national results

U.S. total impact, 2019/20-2021/22 average:

Economic impact: $124 billion

Jobs: People involved in soybean farm decision-making: **504,000**

Full-time equivalent paid jobs provided by soybean value chain: **223,000**

Resident additional family members supported by soybean farms: **62,000**

Wages: $10 billion

The importance of the soybean sector to the U.S. economy remains substantial. This support has been boosted in the past couple of years by higher commodity prices and greater domestic processing within the U.S. national supply chain. We estimate that the U.S. soybean sector provides 223,000 paid full-time equivalent (FTE) jobs to the national economy. In addition, our analysis shows that a further 62,000 family members (beyond the growers themselves) are resident on U.S. soybean farms and are often integral to soybean farming operations. Furthermore, the number of people supported by U.S. soybean farming but not necessarily resident full-time on the farm is greater still, with the USDA Census of Agriculture recording over 504,000 soybean producers based on the involvement in decision-making on U.S. soybean farms in the most recent five-year census period[1].

[1] The multiplier used for this study for farm employment, for example, is 2.13, whereas in the previous study, the farm employment multiplier was 2.54. Other things being equal, this would reduce the *total* employment by close to 20% in this report compared with the previous report.

National Results

Summary

For the average of the three years from 2019/20-2021/22:

- The total contribution to the US economy averaged ***$124 billion per year*** (Table 5). The average masks a steep rise over the past three years from lower production in 2019/20 to very high prices in 2021/22.
- We estimate that the U.S. soybean sector provides ***223,000 paid full-time equivalent (FTE) jobs*** to the national economy. In addition, our analysis shows that a further ***62,000 family members*** (beyond the growers themselves) are resident on U.S. soybean farms and are often integral to soybean farming operations. Furthermore, the number of people supported by U.S. soybean farming but not necessarily resident full-time on the farm is greater still, with the USDA Census of Agriculture recording over ***504,000 soybean producers based on the involvement in decision-making on U.S. soybean farms*** in the most recent five-year census period[2].
- The total ***wage impact*** of the sector averaged $10.0 billion. It is important to note that this values farmer wages (wages that they pay themselves) at their opportunity cost and does not include farm business profits or losses (Table 7).

The economic benefits from soybeans peaked in the most recent year of our report, 2021/22. This coincided with sharp rises in prices for soybeans, and other commodities. This resulted in:

- The soybean sector contributed a total of $160 billion to the U.S. economy in 2021/22. It is worth noting that higher prices alone added over 20% to the 2021/22 value compared with 2020/21 and added over 50% to the impact when compared with 2019/20.
- This is equivalent to 0.6% of U.S. GDP (Gross Domestic Product). In some states, the share of the economy is far higher, upwards of 8% in Iowa and South Dakota.
- Our methodology estimates a 2021/22 total of 306,000 full-time equivalent jobs and resident farm family members supported by the soybean sector, of which almost 68,000 are farm family members (beyond the growers themselves).

[2] *The 223,000 FTE jobs includes the whole soybean value chain, from farming and elevation through processing and transport to end uses and export of the soybean, oil and meal products. This compares directly with the estimates provided in our previous 2019 report, as does the farm family member estimate. The numbers are slightly lower in this report due to the weak U.S. soybean production year in 2019/20 included in the most recent three-year average. The USDA Census of Agriculture estimate of over 504,000 producers includes all those recorded as involved in soybean farm decision making in the most recent USDA farm census. This figure includes people supported by U.S. soybean farms that are not included in our farm employment methodology, such as non-resident stakeholders, and reflects the wider influence of U.S. soybean farming. This number was not included in our previous 2019 report and should not be compared directly with those estimates.*

National results for soybean value chain

National results are presented below for direct and total impact across the various stages in the soybean value chain. We highlight the aggregate results over time in the various diagrams, with the accompanying tables providing the stage-by-state detail. Diagrams 1 and 2 highlight the supply and demand fundamentals that have driven the economic, employment and wage impact of the soybean sector during the reported period.

As explained in the Introduction above, the *direct* impact is calculated manually for various stages in the soybean value chain, with economic, employment and wage multipliers applied to the direct impact in order to estimate the *total* impact.

***Throughout this study, all jobs supported are presented on a full-time equivalent basis**, which we define as an individual working 2,000 hours per year.*

Diagram 1: U.S. soybean output and soybean prices

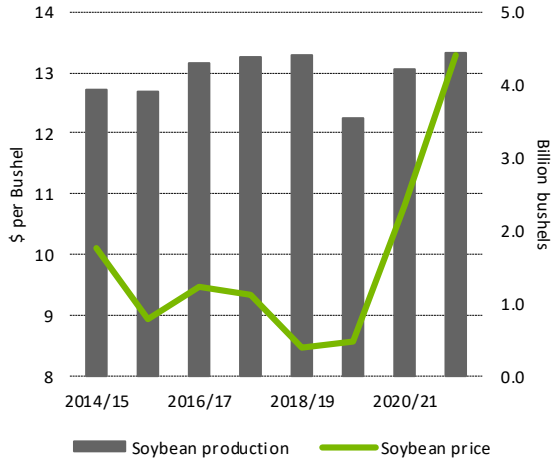
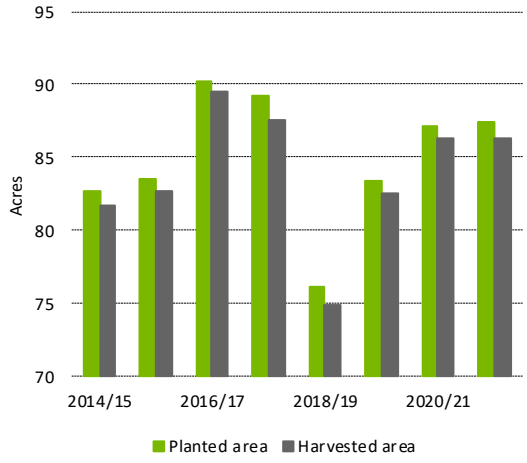
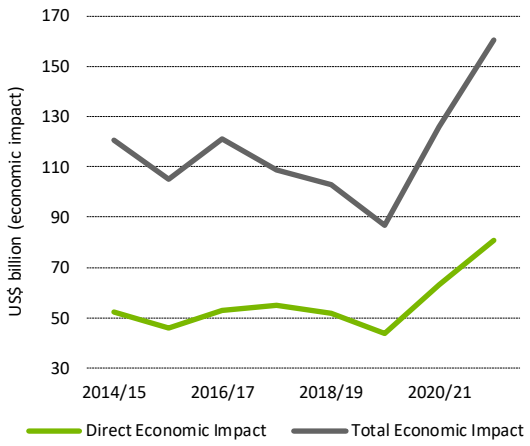


Diagram 2: U.S. soybean planted and harvested area



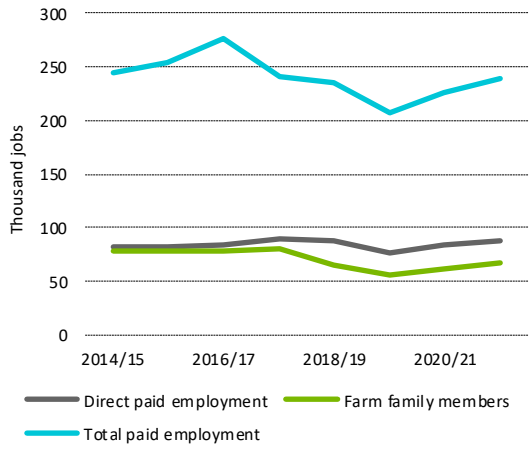
The following diagrams and tables summarize our national level results for U.S. soybeans.

Diagram 3: DIRECT and TOTAL economic impact of U.S. soybeans



- The ***direct economic impact*** has averaged $63 billion during the past three years (up by around $13 billion on the average in the previous 2019 report). But this masks a larger upswing in the most recent years, from $44 billion in 2019/20, to $81 billion in 2021/22.
- The ***total impact*** has increased to a peak of over $160 billion in 2021/22. Steep increases in the past two years have been driven by much higher prices.

Diagram 4: DIRECT and TOTAL full-time (FTE) employment impact of U.S. soybeans



- ***Direct employment***, excluding family members, has averaged around 82,000 (in line with 84,000 in the previous report). Once farm family members are included, U.S. soybeans support, on average, around 285,000 ***people in total*** (lower than the previous report because the BEA's revised multipliers are lower than previously). The direct employment impact has climbed back from its 2019/20 low (when lower output meant fewer *full-time equivalent* jobs needed), to return to levels broadly in line with earlier years.

The number of people supported by U.S. soybean farming but not necessarily resident full-time on the farm is even greater than the numbers generated by our narrower methodology: the ***USDA Census of Agriculture records over 504,000 soybean producers*** based on the involvement in decision-making on U.S. soybean farms in the most recent five-year census period.

Table 1: Steps in the U.S. soybean value chain covered in this study

Value chain component	Description	Economic impact	Employment	Wages	Multiplier used
Soybean farming	Production of soybeans by farmers using land and agricultural inputs like seed, fertilizers and crop protection	yes	yes	yes	yes
Farm family members	Unpaid family members who may indirectly support farm operation	captured in soybean farming	yes	captured in soybean farming	no
Seed delivery	Delivery of seed to crushing facility or point of export via truck, rail and barge	yes	yes	yes	yes
Elevation	Storage of soybeans at country elevators and river elevators.	yes	yes	yes	yes
Crushing	Crushing soybean seed for the manufacture of crude soybean oil and soybean meal	yes	yes	yes	yes
Refining	Refining crude soybean oil for use in edible applications	yes	yes	yes	yes
Biofuels production	Production of biofuels (FAME, RD and SAF) using soybean oil feedstock	yes	yes	yes	yes
Impact at ports	Loading ocean-going vessels for overseas export	yes	yes	yes	yes
Feed Milling	Value added to soy meal in feed compounding, processing and packaging	yes	yes	yes	yes
Long-range rail delivery	Rail delivery of seed, crude oil, refined oil, meal or biofuels to end user or point of export	yes	yes	yes	yes
Long-range barge delivery	Barge delivery of seed, crude oil, refined oil, meal or biofuels to end user or point of export	yes	yes	yes	yes
Savings for livestock sector	Cost savings associated with fulfilling livestock protein demand with soymeal rather than meal alternatives	yes	no	no	yes
Limited end-use	Economic impact from soy oil use in select end products where it comprises primary ingredient like margarine, shortening and salad oil.	yes	yes	yes	yes

Note: FAME - biodiesel, RD – Renewable Diesel, SAF – Sustainable Aviation Fuel.

As the tables demonstrate, soybean production represents by far the most important step in the soybean value chain in terms of its broader impact on the overall economy. The reasons for this are two-fold:

- This reflects a methodological choice in this study. For practical reasons, rather than extending explicit analysis for all the inputs into soybean farming (land, crop protection, seed technology, fertilizers, etc.), we capture the impact of these inputs, along with the value added by the farmer, under the broad heading of soybean production. In effect, therefore, *the production stage, unlike all other stages, does not represent value added at this stage but a sum of all the value added up to and including the soybean production stage.*

- It also is the only stage where the volumes include all the U.S. domestic soybean output. Thereafter, volumes at each stage are reduced by exports of soybeans and soybean products.

Soybean production represents close to 70% of the economic impact of the soy value chain and around 50% of the total of paid jobs.

Finally in this section, the tables below present the various effects step-by-step in the value chain in terms of economic, employment and wage impact.

To capture the end uses of soybean meal and soybean oil, we include categories for the savings enjoyed by the U.S. livestock sector and the major food end uses of vegetable oil in the U.S.

For meal, our assumption is that U.S. soy meal represents *the most competitively priced source of protein for some livestock species, particularly poultry and swine, and* is generally as good as, or better, than competing meals in meeting the protein needs of all livestock species, aside from dairy. We measure this benefit by quantifying the cost saving of local soy meal relative to the major competing meal, assumed to be canola, on a protein-equivalent basis. This per-pound saving is then multiplied by meal use for all species, except dairy, to arrive at a figure for the total saving for U.S. livestock (economic impact).

Access to U.S. soybeans has led to increased savings for the domestic livestock sector over the past decade. This has been due to increases in the volume of domestic soybean meal used over time and also as soybean meal has become more competitively priced against imported canola meal in recent years.

For the value added to soybean oil, we have selected only food uses where the product is reliant on the oil and where the oil component is the dominant ingredient, namely salad oil, shortening and margarine. The food processing sector adds value to soy oil after the refining stage by incorporating refined oil into industrial food applications.

This is the most difficult sector of the value chain to quantify accurately. While we include the estimates from food processing for these limited end uses in our grand totals of the benefits to the U.S. from the soybean industry, we remind readers that they do *not* represent an exhaustive assessment of the end-use benefits of soybeans.

The further processing of refined soy oil into food end uses is difficult to quantify due to the following factors:

- Ingredient use and product formulations of processed foods are sensitive information from the perspective of industrial food manufacturers.

- Branding and marketing add significant value to consumer products. This is the difference between consumer products at this stage of the chain and the commodity products at earlier stages. Branding and marketing make it very difficult to quantify the value that soy can claim in the further processing chain, as the large mark-ups are not attached solely to soy oil — if soy oil were not available, many products would switch to an alternative oil.

Our estimates for the value added in these limited food end uses are calculated as the difference between the wholesale prices of the food product and the price of refined soybean oil. The economic contribution has been fairly stable until this year, as any rise in the price of soy oil tends to be passed on to the consumer in the product price. The volumes used in these sectors are also fairly stable. However, in 2021/22, higher food prices have seen the value added in food uses increase.

Table 2: U.S. DIRECT economic impact ($ billion)

Direct National	2017/18	2018/19	2019/20	2020/21	2021/22	3 year average
Soybean production	40.9	37.3	30.2	45.5	59.0	**44.9**
Local seed delivery	0.7	0.8	0.6	0.6	0.9	**0.7**
Elevation	1.2	1.2	1.0	1.1	1.2	**1.1**
Crushing	3.6	3.6	2.7	4.1	5.5	**4.1**
Refining	0.4	0.5	0.4	1.4	2.5	**1.5**
Biofuels production	0.4	0.6	0.3	0.4	0.0	**0.3**
Impact at ports	2.3	1.9	2.0	1.8	2.1	**2.0**
Feed Milling	0.5	0.5	0.5	0.6	0.7	**0.6**
Long-range rail delivery	2.2	2.3	2.2	2.4	2.5	**2.4**
Long-range barge delivery	0.5	0.4	0.4	0.4	0.6	**0.5**
Savings for livestock sector	1.7	2.1	2.6	3.1	3.7	**3.1**
Limited food end-use	0.7	0.8	0.7	1.7	2.1	**1.5**
TOTAL	**55.1**	**51.9**	**43.7**	**63.3**	**80.7**	**62.5**

Note: Biofuels value in 2021/22 is set to zero. The economic value added is in fact negative in this year due to exceptionally high vegetable oil prices, especially refined oil. The result is that publicly available biofuels prices were often slightly lower than refined oil prices during the year, resulting in negative value added. In reality, biofuels' processors receive payments such as the blenders' credit and RINS which help offset this potential loss. As the sector is still producing output and employing people, its true economic impact cannot be negative. Moreover, a multiplier cannot be applied to a negative value as it would generate an even larger negative value for the total value added. For these reasons, the economic value added cannot be negative, and so we have used a value of zero for 2011/22, and the three-year average includes the value of zero in 2021/22.

Table 3: U.S. DIRECT employment impact (number of full time equivalent jobs)

Direct National	2017/18	2018/19	2019/20	2020/21	2021/22	3 year average
Soybean production	55,160	52,428	44,006	48,478	51,993	48,159
Local seed delivery	3,286	3,301	2,647	3,162	3,326	3,045
Elevation	7,626	7,660	6,143	7,339	7,720	7,067
Crushing	3,096	3,152	3,262	3,225	3,321	3,269
Refining	1,214	1,228	1,180	1,251	1,243	1,225
Biofuels production	1,730	2,095	2,033	2,321	2,541	2,298
Impact at ports	3,278	2,741	2,577	3,048	3,386	3,003
Feed Milling	7,701	7,958	8,162	8,290	8,644	8,365
Long-range rail delivery	4,721	4,582	4,166	3,749	3,944	3,953
Long-range barge delivery	188	165	215	181	181	192
Savings for livestock sector	n/a	n/a	n/a	n/a	n/a	n/a
Limited food end-use	1,778	1,880	1,659	1,954	1,955	1,856
TOTAL	**89,779**	**87,190**	**76,048**	**82,997**	**88,255**	**82,433**
Family farm members	80,809	65,162	55,325	61,449	67,576	61,450
TOTAL (inc farm families)	**170,588**	**152,352**	**131,373**	**144,446**	**155,831**	**143,883**

"Biofuels production" throughout this study includes FAME biodiesel, renewable diesel (RD) and sustainable aviation fuel (SAF).

Table 4: U.S. DIRECT wage impact ($ billion)

Direct National	2017/18	2018/19	2019/20	2020/21	2021/22	3 year average
Soybean production	2.16	2.02	1.80	2.06	2.27	2.04
Local seed delivery	0.16	0.16	0.14	0.17	0.19	0.16
Elevation	0.38	0.39	0.33	0.42	0.44	0.40
Crushing	0.15	0.16	0.17	0.19	0.19	0.18
Refining	0.05	0.05	0.05	0.06	0.06	0.06
Biofuels production	0.07	0.08	0.08	0.10	0.11	0.09
Impact at ports	0.22	0.18	0.18	0.22	0.23	0.21
Feed Milling	0.33	0.35	0.36	0.38	0.42	0.39
Long-range rail delivery	0.38	0.37	0.34	0.29	0.32	0.32
Long-range barge delivery	0.01	0.01	0.01	0.01	0.01	0.01
Savings for livestock sector	n/a	n/a	n/a	n/a	n/a	n/a
Limited food end-use	0.09	0.09	0.08	0.09	0.10	0.09
TOTAL	**4.00**	**3.86**	**3.54**	**3.98**	**4.35**	**3.96**

Table 5: U.S. TOTAL economic impact ($ billion)

Total National	2017/18	2018/19	2019/20	2020/21	2021/22	3 year average
Soybean production	78.0	71.2	57.7	86.9	112.5	**85.7**
Local seed delivery	1.4	1.7	1.3	1.3	1.8	**1.5**
Elevation	2.4	2.4	1.9	2.3	2.5	**2.2**
Crushing	8.7	8.7	6.4	9.8	13.1	**9.8**
Refining	0.9	1.1	1.0	3.5	6.2	**3.6**
Biofuels production	1.1	1.5	0.9	1.1	0.0	**0.6**
Impact at ports	4.7	3.8	4.1	3.7	4.2	**4.0**
Feed Milling	1.0	0.9	0.9	1.2	1.3	**1.2**
Long-range rail delivery	4.0	4.1	4.0	4.3	4.5	**4.3**
Long-range barge delivery	1.0	0.7	0.8	0.9	1.1	**0.9**
Savings for livestock sector	4.2	5.2	6.3	7.6	9.0	**7.6**
Limited food end-use	1.5	1.5	1.4	3.3	4.2	**2.9**
TOTAL	**108.8**	**102.9**	**86.8**	**125.8**	**160.5**	**124.4**

Table 6: U.S. TOTAL employment impact (number of full time equivalent jobs)

Total National	2017/18	2018/19	2019/20	2020/21	2021/22	3 year average
Soybean production	117,532	111,712	93,766	103,294	110,784	102,615
Local seed delivery	14,616	14,681	11,774	14,066	14,796	13,545
Elevation	33,920	34,071	27,324	32,642	34,337	31,435
Crushing	13,773	14,021	14,507	14,347	14,771	14,542
Refining	4,666	4,721	4,537	4,808	4,779	4,708
Biofuels production	6,652	8,053	7,814	8,921	9,768	8,834
Impact at ports	6,267	5,240	4,926	5,827	6,473	5,742
Feed Milling	21,154	21,858	22,419	22,771	23,744	22,978
Long-range rail delivery	15,571	15,113	13,739	12,365	13,007	13,037
Long-range barge delivery	931	817	1,064	896	898	953
Savings for livestock sector	n/a	n/a	n/a	n/a	n/a	n/a
Limited food end-use	4,884	5,165	4,556	5,367	5,371	5,098
TOTAL	**239,966**	**235,451**	**206,425**	**225,302**	**238,728**	**223,485**
Family farm members	80,809	65,162	55,325	61,449	67,576	61,450
Total inc farm family	**320,774**	**300,613**	**261,750**	**286,752**	**306,304**	**284,935**

Table 7: U.S. TOTAL wage impact ($ billion)

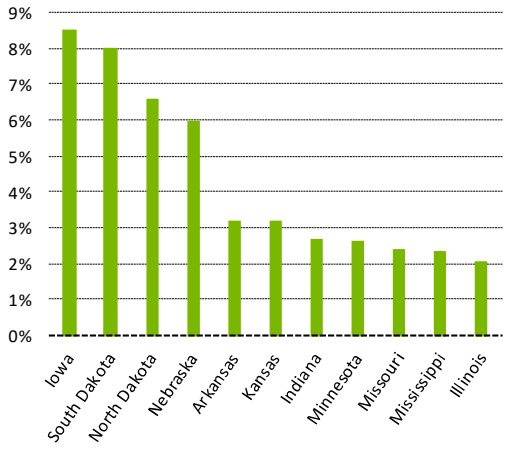
Total National	2017/18	2018/19	2019/20	2020/21	2021/22	3 year average
Soybean production	4.90	4.58	4.08	4.68	5.15	4.64
Local seed delivery	0.52	0.54	0.45	0.56	0.62	0.54
Elevation	1.26	1.29	1.08	1.40	1.47	1.31
Crushing	0.51	0.53	0.57	0.61	0.63	0.61
Refining	0.17	0.17	0.17	0.19	0.20	0.19
Biofuels production	0.22	0.27	0.26	0.31	0.35	0.31
Impact at ports	0.44	0.37	0.37	0.44	0.48	0.43
Feed Milling	0.90	0.95	1.00	1.06	1.16	1.07
Long-range rail delivery	0.83	0.79	0.73	0.62	0.70	0.68
Long-range barge delivery	0.04	0.04	0.04	0.04	0.04	0.04
Savings for livestock sector	n/a	n/a	n/a	n/a	n/a	n/a
Limited food end-use	0.24	0.24	0.21	0.25	0.27	0.24
TOTAL	**10.05**	**9.78**	**8.96**	**10.15**	**11.07**	**10.06**

Note: Totals in tables may not add exactly due to rounding.

State Results

As well as the national results, we have also collected local data that allow us to calculate results for all fifty states as well as select congressional districts (CDs). In this section, we present the 3-year average results by state. Please note that the impact of certain steps in the value chain, e.g. rail or barge transport, cannot be assigned to specific states. Thus, the aggregate of the state totals is less than the national results presented in the previous section.

Diagram 6: Soybean share of state GDP



The regional importance of soybeans is illustrated by the next set of diagrams, with the Midwestern states being well represented among the top states in terms of economic and employment impacts. In Illinois, however, the presence of Chicago reduces the *relative* importance of farming in the state economy.

We also present total results, by state, in the maps on the final pages of this section. The maps further highlight the economic impact of soybeans in the Midwest.

Diagram 7: State distribution of TOTAL economic impact

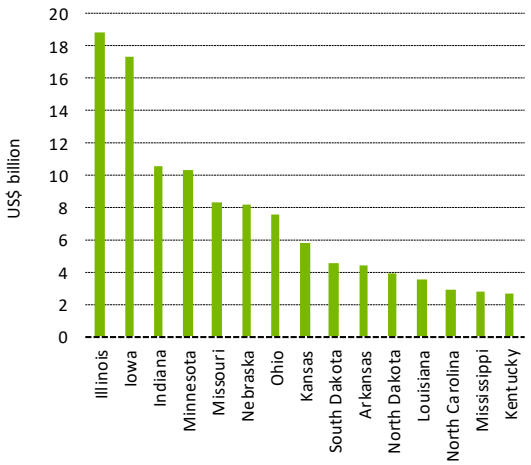
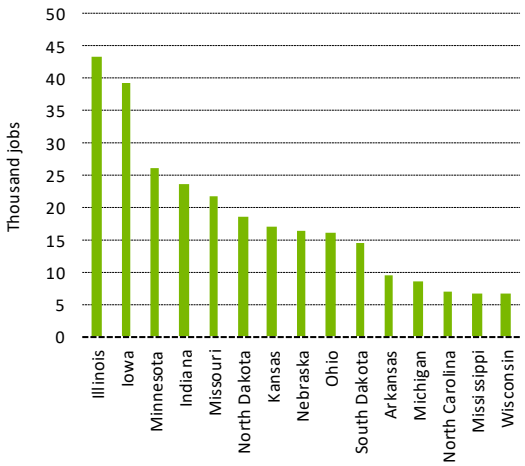


Diagram 8: State distribution of TOTAL FTE employment impact



The state results are subject to annual volatility because of variability in the underlying data. While revenue in all sectors is volatile because of fluctuating prices, farming jobs and farm family members, for example, are linked to annual state soybean area, which varies over time, and has fallen in some states. Crushing, feed milling, refining and biofuels jobs are linked to annual state capacity estimates, and so the opening or closing of one facility can affect state (and of course CD) numbers quite substantially. For national totals, these local fluctuations tend to even out. Transport and food use jobs are driven by soybean output, which is also subject to annual variations.

Table 8: DIRECT and TOTAL results, by state, average 2019/20 – 2021/22

State	Direct Economic $ million	Direct Employment Jobs (FTE)	Direct Wage $ million	Farm family	Total Economic $ million	Total Employment Jobs (FTE)	Total Wage $ million
Alaska	1	21	1	0	2	24	2
Alabama	541	568	25	214	1,322	1,638	66
Arkansas	1,958	3,353	135	2,108	4,364	7,499	344
Arizona	21	60	3	0	46	116	8
California	257	389	19	0	536	1,001	49
Colorado	29	154	7	0	70	448	22
Connecticut	2	42	2	0	3	74	4
Delaware	136	165	7	115	256	342	12
Florida	29	92	5	0	55	150	12
Georgia	572	541	26	77	1,404	1,598	76
Hawaii	5	74	5	0	8	37	10
Iowa	7,772	12,725	526	7,177	17,020	34,266	1,382
Idaho	10	59	3	0	25	200	8
Illinois	7,976	12,536	511	7,698	18,834	36,653	1,433
Indiana	4,548	7,295	302	4,191	10,331	21,737	810
Kansas	2,650	5,883	239	3,543	5,725	13,959	596
Kentucky	1,270	2,286	93	1,348	2,744	5,282	240
Louisiana	1,778	2,453	136	754	3,697	5,900	299
Massachusetts	1	28	2	0	2	15	4
Maryland	469	698	30	363	840	1,345	63
Maine	1	8	0	0	2	23	1
Michigan	1,329	2,781	119	1,524	2,641	5,991	288
Minnesota	4,734	9,295	382	5,479	10,184	25,111	985
Missouri	3,655	6,942	282	4,155	8,375	17,543	763
Mississippi	1,315	2,316	93	1,492	2,808	4,815	224
Montana	25	80	4	0	59	150	10
North Carolina	1,219	2,075	85	1,195	2,857	4,966	223
North Dakota	2,129	6,975	280	4,653	4,074	18,084	633
Nebraska	3,782	6,467	265	3,882	8,093	20,001	679
New Hampshire	0	4	0	0	0	6	0
New Jersey	68	128	5	72	130	205	12
New Mexico	9	46	2	0	16	94	5
Nevada	3	5	0	0	5	10	1
New York	214	569	27	217	361	932	52
Ohio	3,434	5,808	237	3,532	7,533	13,253	612
Oklahoma	248	804	33	397	576	1,980	85
Oregon	260	206	12	0	537	993	29
Pennsylvania	485	1,209	51	457	988	2,603	131
Rhode Island	0	7	0	0	1	25	1
South Carolina	274	471	20	260	556	1,063	48
South Dakota	2,419	5,196	209	3,437	4,529	14,066	462
Tennessee	946	1,899	77	1,148	2,030	4,108	199
Texas	549	1,713	86	64	1,474	4,924	262
Utah	21	50	2	0	52	155	6
Virginia	577	1,090	52	432	1,123	2,074	114
Vermont	2	19	1	0	3	37	2
Washington	180	373	21	0	368	894	48
Wisconsin	1,165	2,591	106	1,466	2,477	6,966	280
West Virginia	20	45	2	0	34	104	4
Wyoming	10	9	0	0	18	25	1

Diagram 9: TOTAL economic impact by state, US$ million, average 2019/20 – 2021/22

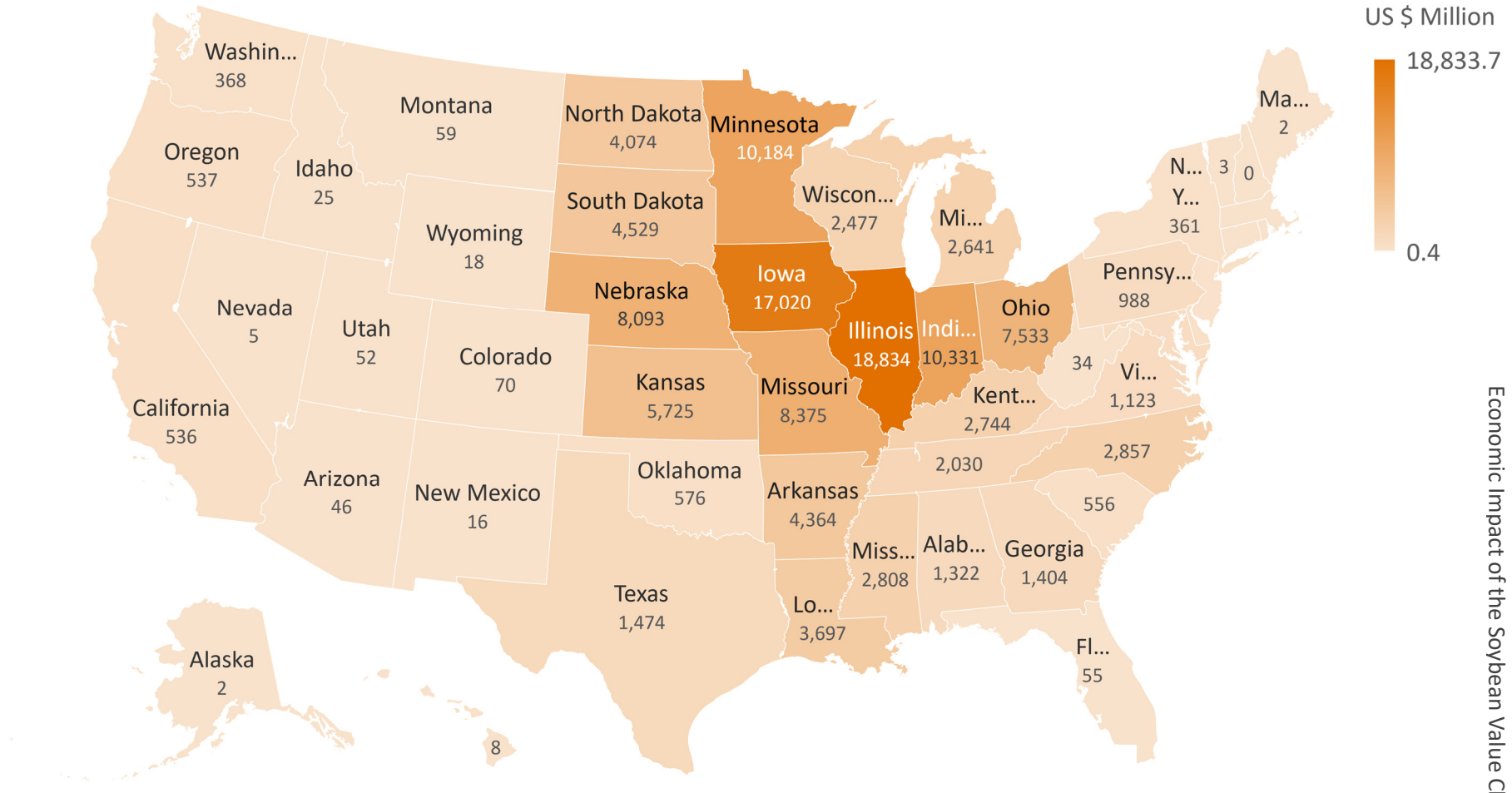


Diagram 10: TOTAL employment impact (number of full time equivalent jobs) by state, average 2019/20 – 2021/22

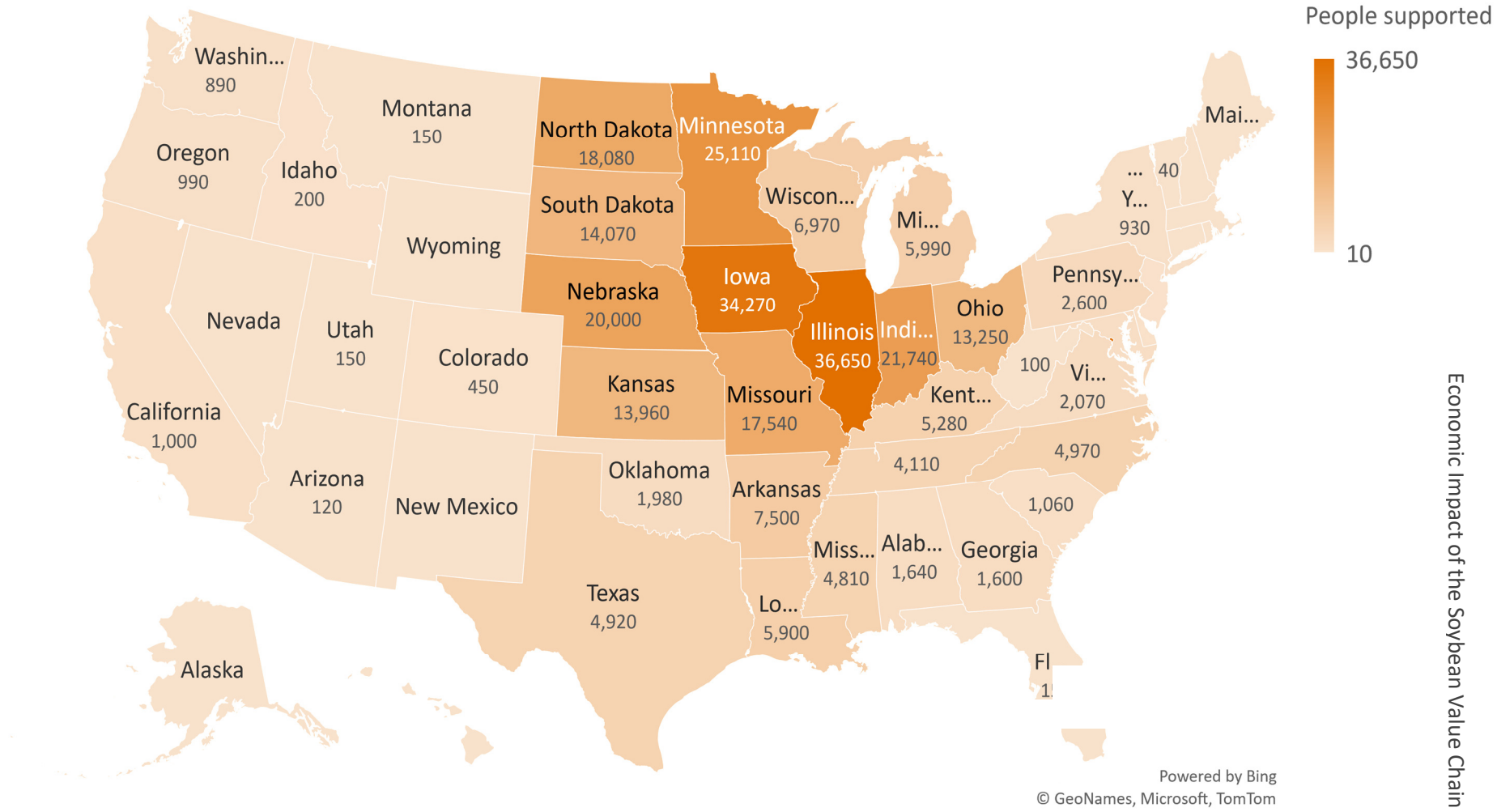
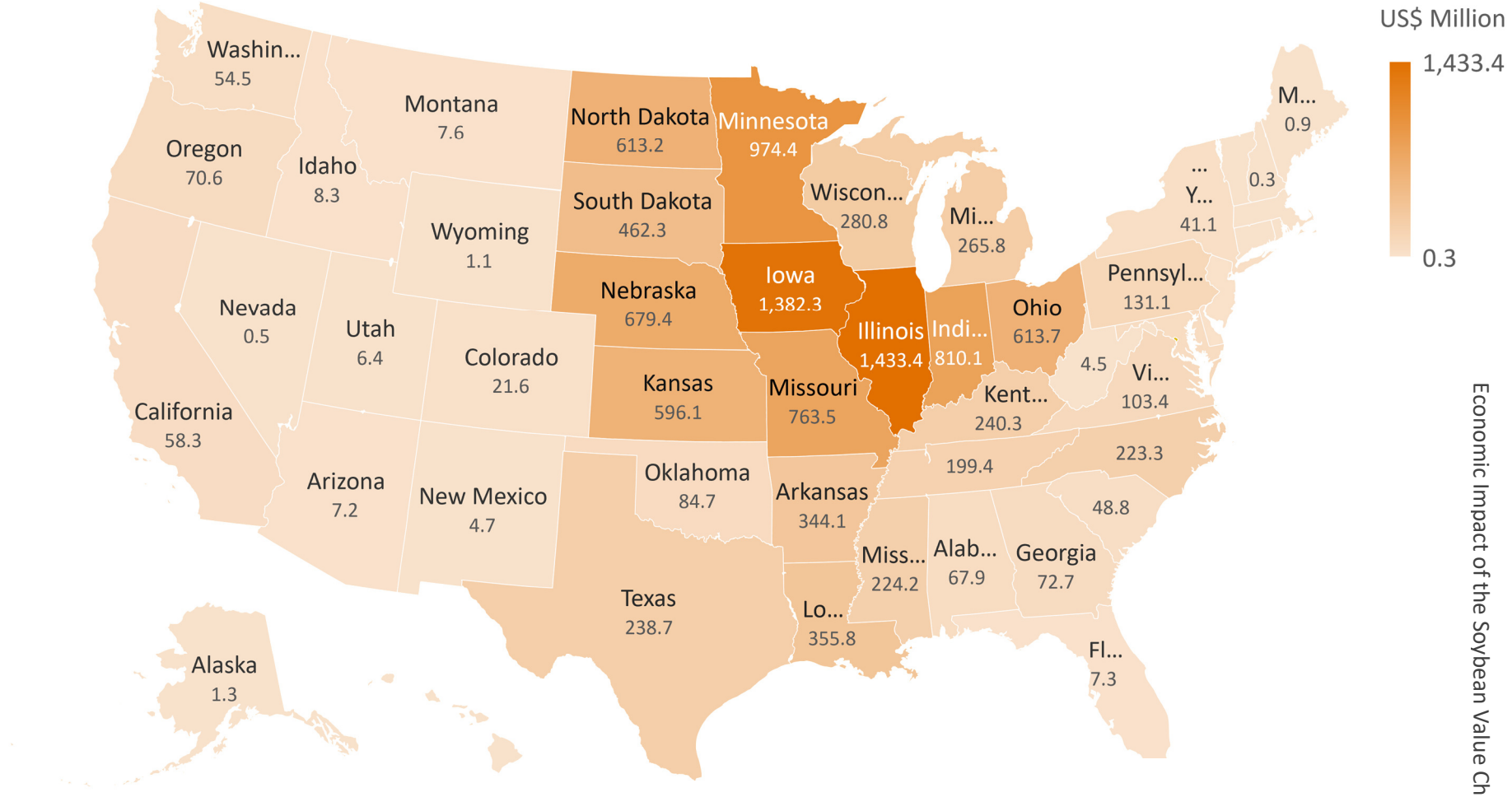


Diagram 11: TOTAL wage impact by state, US$ million, average 2019/20 – 2021/22



Congressional District Results

Introduction

The previous section presented information on the relative importance of individual states in terms of their contribution to the soybean value chan. These results reflect the states' relative importance in terms of soybean production and processing. These can also be broken down further into the contributions made by individual Congressional districts (CDs) to the state and national totals.

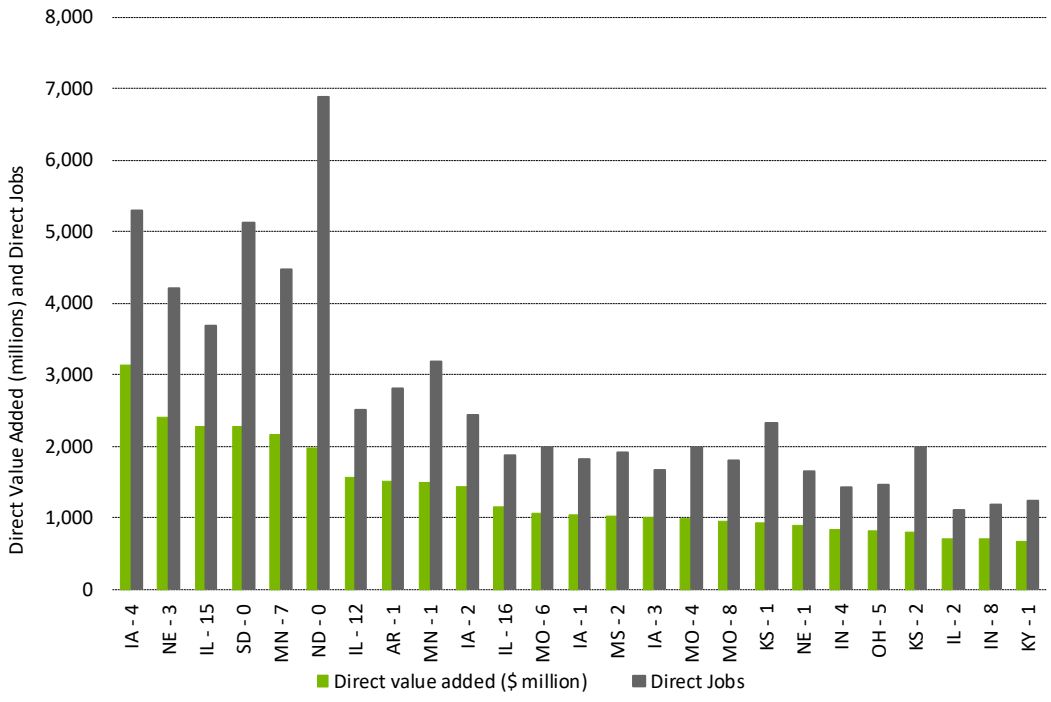
In this section, we summarize the results for the direct and total impact of the soybean value chain in 106 Congressional districts, as selected by the USB and NOPA. The districts listed are based on the redistricting for the 118th Congress.

We do not disaggregate the CD results by stage in the value chain and, as with the state totals, we do not include figures for long range delivery of soybeans and soybean products by CD. Note we also do not cover every CD in each state, and therefore state totals do not equal the sum of the CDs presented here.

The direct and total impact for the 106 selected CDs are presented in Table 10, with the districts listed for Tables 9 and 10 again based on the redistricting for the 118th Congress.

Diagrams 12 and 13 below highlight the largest impact by CDs in terms of direct economic value added and direct employment. Value added figures in the "farming" diagram are driven largely by soybean production and prices, whereas farming jobs are driven by farming area under soybeans. For this reason, CDs with lower soybean yields, with the North Dakota CD a prime example, have proportionately high numbers of jobs compared with value added.

Diagram 12: DIRECT value added for major farming CDs, average 2019/20 – 2021/22



The aggregate data are split into two categories:

- The **farming** category presents the value added and employment in the farming, crop delivery, elevation, feed milling and livestock benefit (value added only) sectors.
- The **industrial** category sums the value added and employment for the crushing, refining, biofuels, ports and food use sectors.

Diagram 13: DIRECT value added for major processing CDs, average 2019/20 – 2021/22

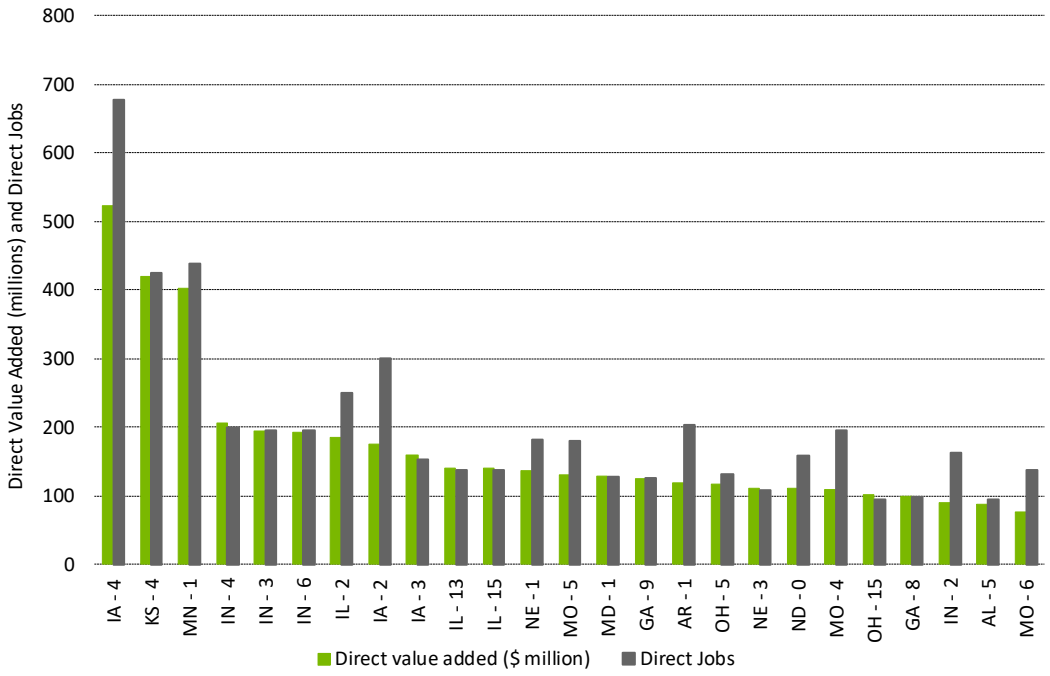


Table 9: Representatives for Congressional districts with major contributions to TOTAL soy value chain (averages for 2018/19 to 2020/21, TOTAL impact, excluding farm family members)

			
Randy Feenstra- IA 4 Bil. • $8.7 • 17,100 Mil. • $700	**Dusty Johnson-SD AL** • $4.5 • 14,000 • $460	**Mary Miller- IL 15** • $5.5 • 10,800 • $420	**Michelle Fischbach-MN 7** • $4.5 • 11,300 • $440
			
Adrian Smith- NE 3 Bil. • $5.4 • 13,100 Mil. • $400	**Kelly Armstrong- ND AL** • $4.1 • 18,600 • $633	**Brad Finstad- MN 1** • $4.8 • 11,400 • $450	**Mike Bost - IL 12** • $3.8 • 7,200 • $280
			
Ashley Hinson- IA 2 Bil. • $3.5 • 7,300 Mil. • $300	**Rick Crawford- AR 1** • $3.5 • 6,700 • $310	**Darin LaHood- IL 16** • $2.7 • 5,300 • $210	**Tracey Mann - KS 1** • $1.9 • 5,200 • $220
			
Zach Nunn- IA 3 Bil. • $2.6 • 4,800 Mil. • $200	**Jim Baird- IN 4** • $2.4 • 4,800 • $182	**Jake LaTurner- KS 2** • $1.8 • 4,700 • $200	**Sam Graves- MO 6** • $2.6 • 5,300 • $230

Table 10: DIRECT and TOTAL impact by Congressional districts, average 2019/20 – 2021/22

Congressional District	Direct Economic $ million	Direct Employment Jobs (FTE)	Direct Wage $ million	Farm family	Total Economic $ million	Total Employment Jobs (FTE)	Total Wage $ million
AL - 4	136	212	9	118	294	530	23
AL - 5	227	225	10	63	555	644	27
AR - 1	1,627	3,021	121	1,941	3,463	6,701	308
AR - 2	40	55	2	35	94	117	6
AR - 4	215	247	10	131	565	567	27
DE - 0	136	165	7	115	256	342	12
GA - 8	133	132	7	12	301	433	19
GA - 9	202	177	9	5	494	618	27
IL - 2	934	1,402	59	752	2,323	4,569	183
IL - 12	1,637	2,579	105	1,678	3,778	7,230	284
IL - 13	696	945	40	450	1,819	3,169	129
IL - 14	196	388	16	220	449	1,249	47
IL - 15	2,412	3,816	155	2,452	5,603	10,763	422
IL - 16	1,195	1,911	77	1,252	2,746	5,342	208
IL - 17	676	1,066	44	691	1,560	2,980	118
IN - 1	79	141	6	92	166	388	14
IN - 2	489	870	36	438	1,139	2,867	106
IN - 3	760	1,188	50	617	1,777	3,564	138
IN - 4	1,040	1,623	67	924	2,386	4,775	182
IN - 5	375	620	25	415	795	1,640	60
IN - 6	686	1,036	44	550	1,617	3,203	123
IN - 8	775	1,243	51	794	1,703	3,459	129
IN - 9	342	571	23	358	743	1,558	58
IA - 1	1,076	1,910	77	1,152	2,263	4,659	192
IA - 2	1,604	2,727	112	1,558	3,485	7,280	295
IA - 3	1,203	1,871	77	1,112	2,621	4,816	199
IA - 4	3,889	6,217	260	3,355	8,650	17,118	696
KS - 1	935	2,326	92	1,531	1,940	5,165	220
KS - 2	853	2,034	82	1,278	1,827	4,686	202
KS - 4	758	1,273	54	561	1,741	3,472	151
KY - 1	674	1,237	50	761	1,422	2,599	123
KY - 2	414	730	30	398	927	1,989	83
KY - 4	66	118	5	81	132	228	11
LA - 3	14	28	1	19	28	54	3
LA - 4	87	156	6	82	207	337	16
LA - 5	524	976	39	643	1,130	2,024	96
LA - 6	7	15	1	10	15	29	1
MD - 1	383	548	24	264	686	1,038	50
MI - 2	223	419	18	222	454	1,040	45
MI - 3	17	38	2	20	33	90	4
MI - 4	106	247	11	87	220	683	30
MI - 5	332	703	28	427	651	1,568	69
MI - 6	29	53	2	37	56	112	5
MI - 7	185	341	14	237	360	717	31
MI - 8	135	249	10	171	262	524	23
MI - 10	6	10	0	7	11	22	1
MN - 1	2,097	3,840	161	1,961	4,841	11,438	453
MN - 2	102	187	8	124	206	464	18
MN - 6	86	164	7	111	173	401	16
MN - 7	2,209	4,529	181	2,968	4,485	11,348	439
MN - 8	109	296	15	132	217	692	33
MS - 1	140	247	10	158	301	514	24
MS - 2	1,035	1,927	77	1,314	2,108	3,849	183
MS - 3	109	130	5	20	307	416	16
MO - 3	190	371	15	231	425	849	38

Table 10: DIRECT and TOTAL impact by Congressional districts, average 2019/20 – 2021/22 *(continued)*

Congressional District	Direct Economic $ million	Direct Employment Jobs (FTE)	Direct Wage $ million	Farm family	Total Economic $ million	Total Employment Jobs (FTE)	Total Wage $ million
MO - 4	1,122	2,207	89	1,282	2,602	5,804	246
MO - 5	154	222	11	29	456	1,329	45
MO - 6	1,144	2,121	87	1,273	2,602	5,336	233
MO - 7	65	152	6	56	166	458	19
MO - 8	945	1,801	71	1,239	2,046	3,774	176
NE - 1	1,039	1,826	67	988	2,264	5,704	174
NE - 3	2,528	4,316	165	2,707	5,360	13,135	412
NY - 23	13	34	1	15	21	66	3
NY - 24	114	269	11	139	189	517	21
NC - 1	291	647	25	448	639	1,430	63
NC - 3	375	582	24	327	922	1,354	63
NC - 4	11	26	1	19	24	57	3
NC - 7	139	186	8	85	342	451	22
NC - 8	79	160	6	108	181	355	16
NC - 9	92	112	5	33	217	334	15
NC - 13	116	162	7	70	265	476	20
ND - 0	2,129	6,975	280	4,653	4,074	18,600	633
OH - 2	406	709	28	481	848	1,400	68
OH - 4	614	1,076	43	684	1,304	2,209	108
OH - 5	938	1,595	66	935	2,103	3,834	175
OH - 6	55	97	4	62	117	200	10
OH - 7	46	81	3	45	100	179	9
OH - 8	212	376	15	236	452	776	38
OH - 10	61	106	4	70	129	213	10
OH - 12	220	396	16	242	475	841	41
OH - 15	437	635	27	332	1,043	1,728	76
OK - 2	79	262	11	95	195	724	30
OK - 3	150	474	19	255	344	1,122	49
PA - 4	11	28	1	11	23	58	3
PA - 11	75	123	10	60	159	251	11
PA - 16	46	115	5	58	88	232	11
SC - 5	21	49	2	35	41	104	5
SC - 6	58	115	5	75	118	249	11
SC - 7	80	188	7	130	161	400	17
SD - 0	2,419	5,196	209	3,437	4,529	14,009	462
TN - 4	126	264	11	146	268	618	29
TN - 6	41	89	4	43	88	222	10
TN - 7	58	114	5	78	120	227	11
TN - 8	608	1,211	48	805	1,271	2,475	120
VA - 1	76	168	7	118	137	281	13
VA - 2	60	128	5	76	114	234	11
VA - 3	40	36	2	0	97	160	7
VA - 4	45	100	4	67	82	171	8
VA - 5	50	99	4	53	97	192	9
WI - 1	94	212	9	120	198	582	23
WI - 2	220	488	20	273	468	1,311	53
WI - 3	300	788	33	348	649	2,281	93
WI - 5	79	158	6	104	167	400	16
WI - 6	162	318	13	210	342	804	30
WI - 7	166	327	13	214	351	828	30
WI - 8	101	190	8	126	213	482	18

Methodology

Summary

The **direct** results in this report are based on manual calculations using public data sets, stakeholder interviews and LMC industry knowledge.

Total results include *indirect* effects as well as *induced* effects associated with household spending, in addition to the *direct* effects. These are estimated by applying economic multipliers to the direct results. In the following pages, we provide an overview of how the impact is calculated, by step, in the soybean value chain.

Production, crop delivery and elevation

Because it is an input-intensive sector, **soybean production** (farming) supports many upstream industries. These include production and distribution of fuel, fertilizers, crop protection, machinery, water and seed technology, among others. Rather than attempting to calculate a separate impact for each of the many input sectors, we have instead combined all of these under the broader heading of "soybean production," along with the value added to these inputs by the farmer themselves.

The economic impact of soybean production is therefore calculated the price of soybeans multiplied by soybean output. Thus, unlike all the downstream sectors hereafter, the soybean production does not represent the value added by the farmer: it is the aggregate of all steps up to and including the farming stage. This is one reason why the value added for soybean farming is far greater than other sectors covered in the report.

For soybean prices, we use U.S. Department of Agriculture (USDA) state-level farmgate prices (Diagram 14).

Diagram 14: U.S. soybean prices and production

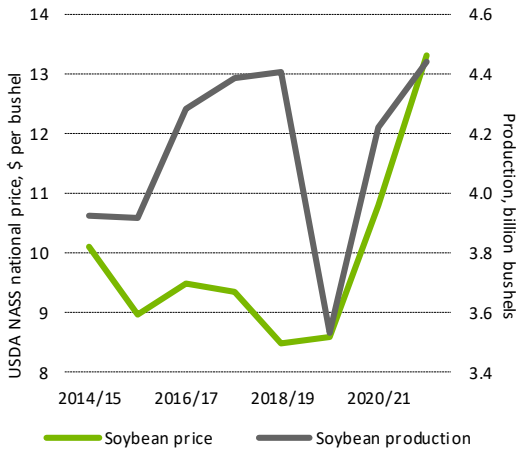
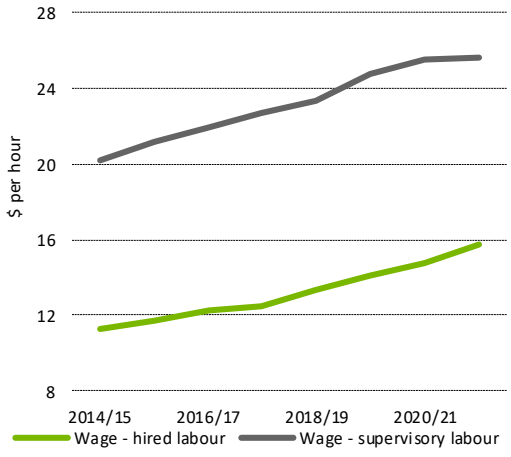


Diagram 15: Wages rates in soybean production



To address the employment and wage impact of soybean production, we began with USDA Economic Research Service (ERS) budgets that are developed annually for major field crops, including soybeans. These ERS budgets report labor costs for hired labor as well as the opportunity cost of time for unhired labor. These are translated into hours using USDA NASS

wage data (Diagram 15). ERS budgets also report a cost for Custom Operations, although this includes components other than labor, including machinery, fuel and other inputs. The labor share of Custom Operations costs was assumed to be the same as the share of hired + management labor costs relative to total operating costs (around 15%). This total labor cost of custom operations was then translated to an hour figure by dividing by the hired wage series.

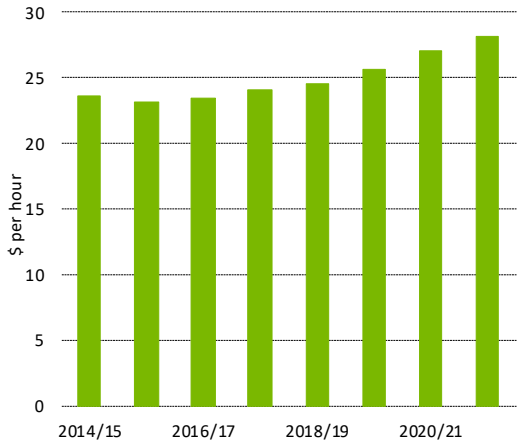
Although USDA provide data on state and even county-level production, it does not consistently provide this data by congressional district. To estimate soybean production volumes by congressional district, we took a geospatial approach, overlaying USDA National Agricultural Statistics Service (NASS) crop-scape data, which interprets satellite imagery to define commodity production by field, with political boundaries for the 118th Congress of the United States. Using a series of tools available in ArcView GIS, soybean acres were tallied for each of the 107 selected congressional districts. In recent years, these totals have been remarkably accurate, differing from USDA's official national totals by less than 5%.

Throughout this study, all jobs supported are presented on a full-time equivalent basis, which we define as an individual working 2,000 hours per year. Because of the part-time nature of many growers' soybean-related activities, *the full-time equivalent of jobs* supported is less than the number of growers of soybeans and the number of people involved in the production of the crop.

We estimate that the U.S. soybean sector provides 223,000 paid full-time equivalent (FTE) jobs to the national economy over the whole soybean value chain, from farming and elevation through processing and transport to end uses and export of the soybean, oil and meal products. This compares directly with the estimates provided in our previous 2019 report. In addition, our analysis shows that a further 62,000 family members (beyond the growers themselves) are resident on U.S. soybean farms and are often integral to soybean farming operations. Again, this can be compared directly with the estimate provided in our previous 2019 report.

The number of people supported by U.S. soybean farming but not necessarily resident full-time on the farm is greater still, with the USDA Census of Agriculture recording over 504,000 soybean producers based on the involvement in decision-making on U.S. soybean farms in the most recent five-year census period. The USDA Census of Agriculture estimate includes all those recorded as involved in soybean farm decision making in the most recent USDA farm census. This figure includes people supported by U.S. soybean farms that are not included in our farm employment methodology, such as non-resident stakeholders, and reflects the wider influence of U.S. soybean farming. This number was not included in our previous 2019 report and should not be compared directly with those estimates.

Diagram 16: Crop delivery (trucking) wage rates



After soybeans are grown and harvested, they are most often trucked to an **elevation** facility and less often trucked directly to a crushing facility.

Elevated volumes are adjusted each year on the basis of crop size.

Value added in elevation is calculated as the estimated volume elevated multiplied by the estimated elevation fee, averaging around 25 cents per bushel.

Jobs associated with elevation came from press releases discussing the employment effect of local elevator closures and openings.

Wages for elevator workers, meanwhile, were assumed to be the same as those for crush plant workers, a series reported by the Department of Labor's Bureau of Labor Statistics (BLS).

Finally, the geographic distribution of elevation was based on a USDA database on licensed and unlicensed grain elevators.

Whether soybeans are being processed domestically or shipped internationally, they first must be trucked from the farm, adding value in our **crop delivery** stage. Average distances, determined by interviews, along with trucking rates reported by the USDA Agricultural Marketing Service (AMS), form the basis for the value added in crop delivery from the farm (which we assume all takes place on trucks).

The number of jobs supported in local soybean trucking is estimated on the basis of the time required to cover the average distances, keeping the full-time equivalent job assumption in mind. Trucking wages, like many other wages series used in this study, come from BLS.

Crushing, refining and biofuel production

Crushing, refining and biofuel production all represent forms of processing where further value is added to soybeans.

The value added in **crushing** is estimated as the value of by-products (oil, meal and hulls) minus the value of soybeans. We adopt yields previously reported by USDA ERS from several individual crushers, reported first through NASS. Spot prices for central Illinois are reported by the USDA AMS. It is important to note that the series aims to construct an indicator for the sector as a whole rather than reflecting the specific experience of any individual crusher.

Value added per bushel is used in conjunction with total volumes crushed to arrive at a national total for economic impact. This total is then allocated across crush districts on the basis of estimates for crush by plant, based on estimates of individual plant capacities.

The economic impact for **refining soybean oil** for both edible applications and biofuels (which include FAME biodiesel, renewable diesel and sustainable aviation fuel) is calculated in a similar way: the impact equals value added per pound of oil multiplied by estimates of pounds processed.

The value added per pound of oil is based on the spread for Illinois crude oil prices, reported by the USDA, and Illinois refined prices, reported by *The Jacobsen*. Volumes of refined for edible applications are determined, using USDA data, as use minus exports and domestic use for biofuel production. National totals are then allocated across states and congressional districts on the basis of the soy oil refining capacity of individual plants.

The **biofuels production** impact is calculated in the same manner, allowing for the fact that soybean oil typically accounts for around 50% of feedstocks used for biofuels production annually.

Diagram 17: Price and value per bushel of soybeans, hulls, meal and oil

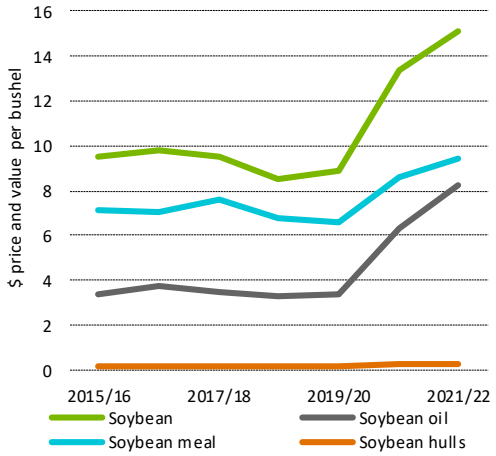
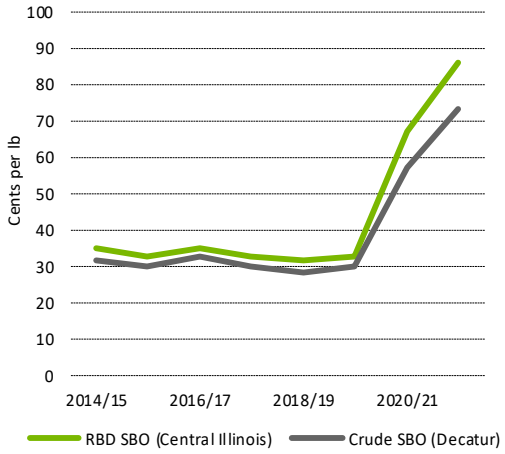
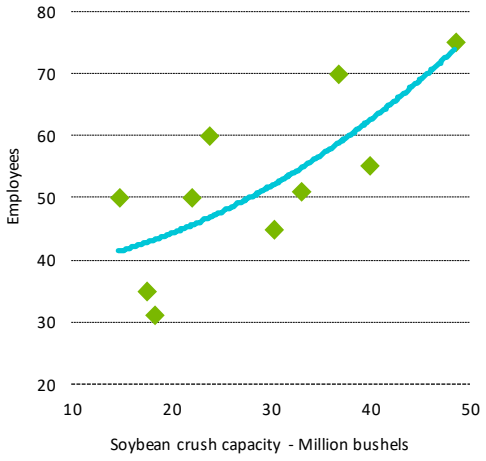


Diagram 18: Crude and RBD soybean oil prices



The employment impact is estimated by obtaining estimated employment figures for individual crush plants, refineries and biofuel facilities through a combination of press reports as well as interviews with industry stakeholders.

Diagram 19: Staffing estimates for U.S. crush plants by capacity



This cross-section of employment data is then extrapolated to all processing facilities based on known relationships between capacity and individuals employed (Diagram 19).

Wage data for crushing and refining was obtained from BLS.

Diagram 20: Estimated share of U.S. soy crush, by region

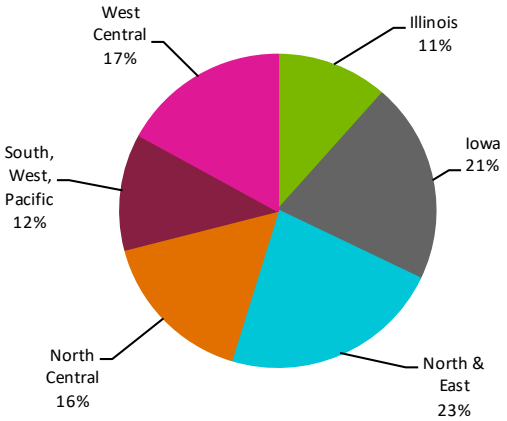
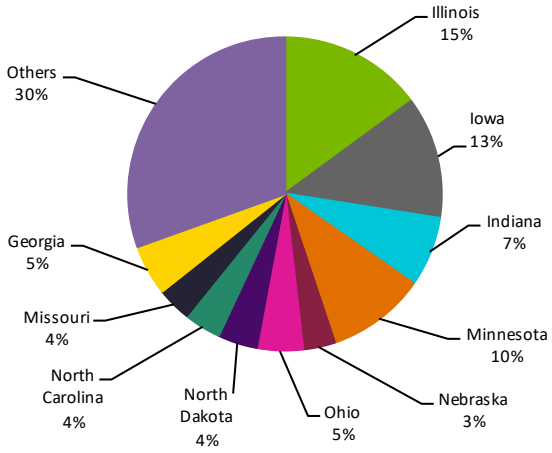


Diagram 21: Estimated share of U.S. soy oil refining, by state



Livestock and feed milling impact

Essentially, all meal crushed from commodity soybeans is fed to livestock, with about 75% of domestic production being used within the United States. While soymeal is an integral part of **livestock production**, it is important to recognize that livestock production is a distinct industry, and soybean's claim to economic impact in this domain is inherently limited: if there were no U.S. soybeans, it does not follow that the U.S. would have no livestock industry.

Nevertheless, U.S. soymeal offers tangible benefits to the U.S. livestock sector in terms of being *the most competitively priced source of protein for some livestock species, particularly poultry and swine*. We adopt the assumption that soymeal is generally as good as, or better, than competing meals in meeting the protein needs of all livestock species, aside from dairy.

We then view the benefit of soy meal as its cost saving relative to the major competing meal, assumed to be canola, on a protein-equivalent basis (Diagram 22) recognizing that the vast majority of canola meal is fed to the dairy sector and that conversely, species like poultry meet the majority of their protein needs through soy. This per-pound savings is then multiplied by meal use (Diagram 23) for all species, except dairy, to arrive at a figure for economic impact.

No employment or wages paid in the livestock sector are credited toward the soy value chain in this study.

Diagram 22: Soybean and canola meal prices (SBE equivalent)

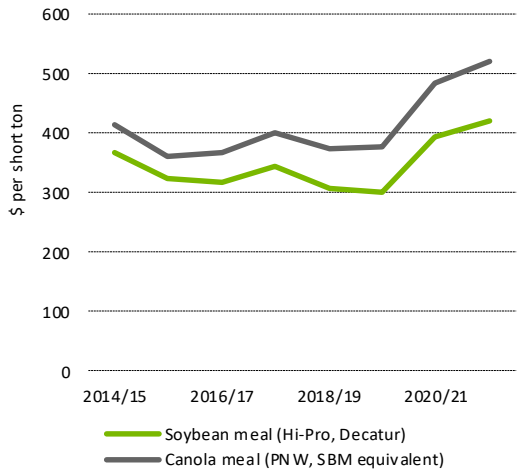
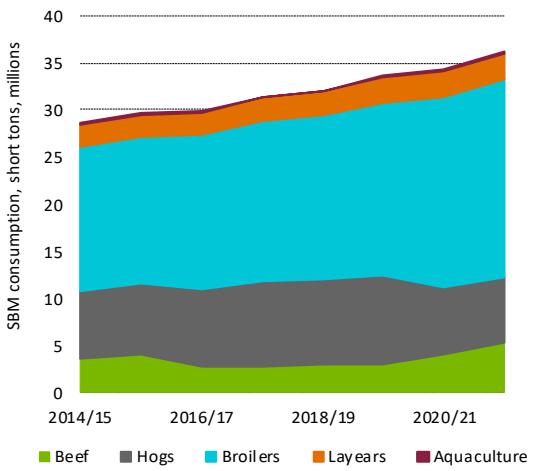


Diagram 23: Soy meal consumption estimate per livestock species



We also cover **feed compounding** of soybean meal. Conservatively, value added from feed milling was set equal to the spread between loose meal and meal pellets over the observed timeframe.

The geographical impact of feed milling was allocated based on a comprehensive feed mill list maintained by the U.S. Food and Drug Administration.

Employment and wage data associated with feed milling are obtained from BLS. Employment is adjusted to reflect the fact that soymeal is but one ingredient used in feed milling.

Soy product transportation and port activities

U.S. soybeans and soy products may be transported from America's heartland across the country by rail and/or barge before reaching the customer. Distances can range from hundreds to thousands of miles, particularly in the case of U.S. export shipments. For example:

- Soybeans and soy products intended for export are arguably going to travel the longest distance from point of origin to final destination. In most cases, they are loaded onto rail cars or barges before ultimately reaching a U.S. port to be loaded onto a vessel and sent out to sea.

- Barges and rail are also common means of delivering soybean meal and vegetable oil shipments from crush plants in the Midwest to livestock consumption centers located along the coasts as well as to Western and Southeastern states.

Diagram 24: TOTAL U.S. railroad employees, by year

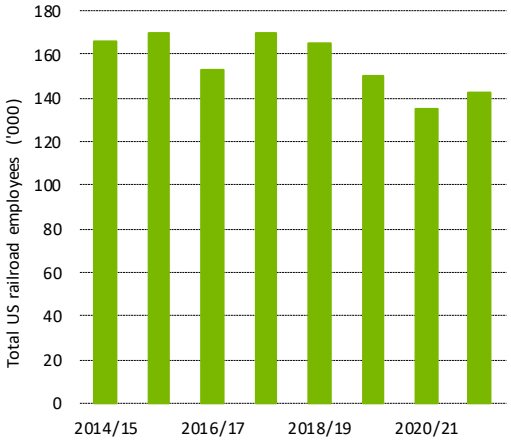
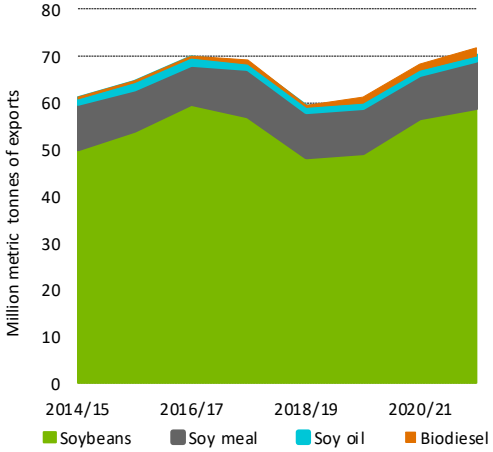


Diagram 25: U.S. exports of soybean products



We use weigh bill data for soy products to determine volumes and rates, with value added calculated as a function of the two.

Rail employment, salaries paid and total ton-miles of products shipped are obtained from the Association of American Railroads, with soy's share of rail employment taken to be its share of all rail shipments — generally less than 0.5%. *As rail shipments are conducted long range, across a national network, we did not assign the impact associated with soy shipments to any particular congressional district.*

The impact associated with barge shipments is calculated as for rail, albeit with volume data obtained from the U.S. Army Corps of Engineers and rate data obtained from USDA AMS.

Diagram 26: Barge volumes for soybeans and soybean meal

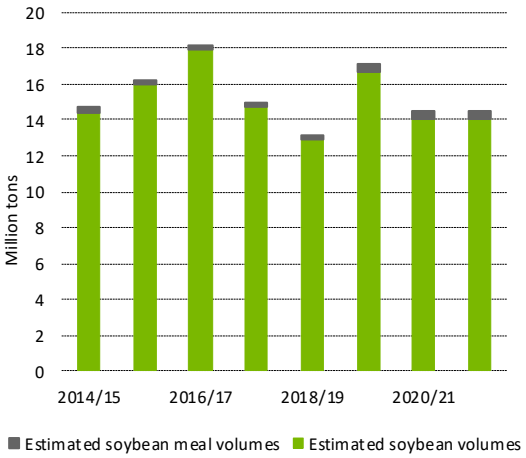
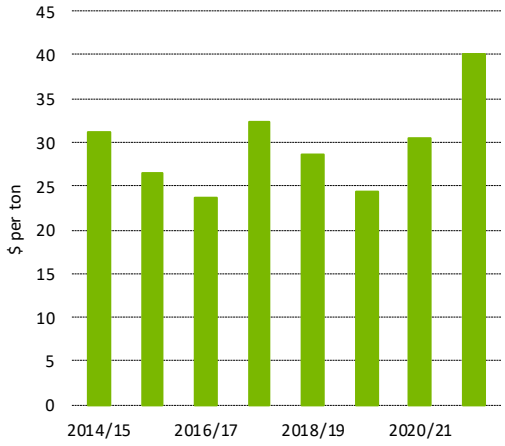


Diagram 27: Barge rates per ton, 2014/15-2021/22



The final economic impact for exported soy products is felt at U.S. ports.

Value added at the port is estimated as the spread between the export terminal price and the FOB price, based on public data available via the U.S. International Trade Commission and the total volumes imported and exported through U.S. ports as reported by the American Association of Port Authorities.

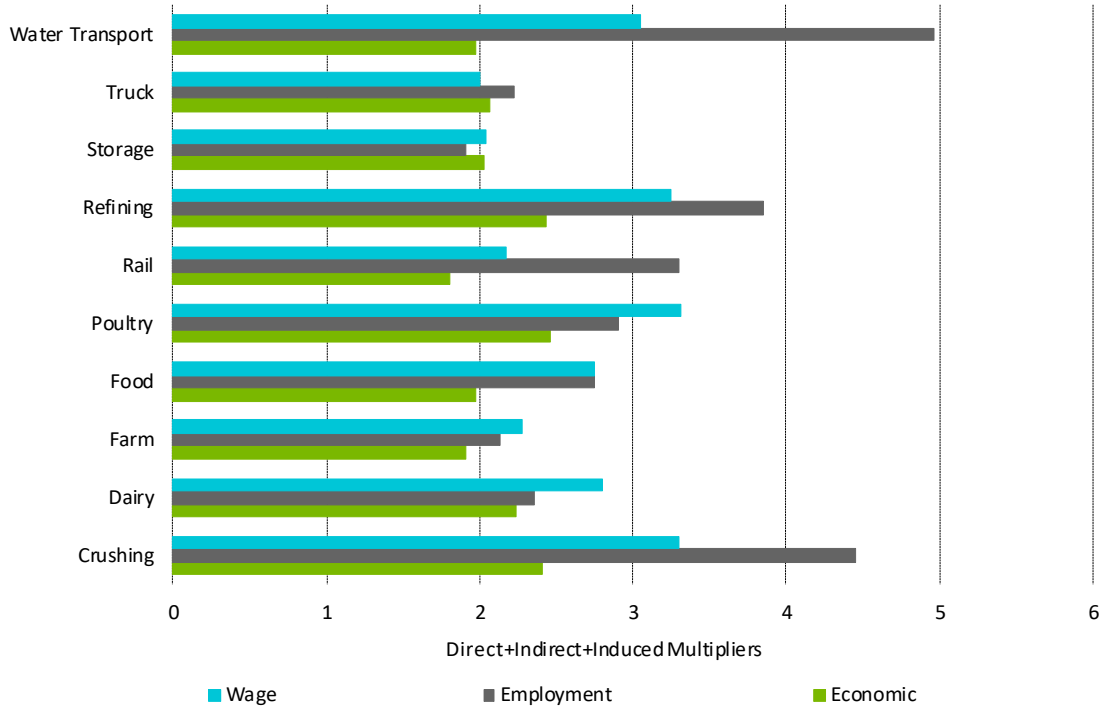
Soy employment at ports is a function of the soy share of total port movements and total port employment figures reported by BLS, which also serves as the source for wage data.

Multiplier effects

As the national results highlight, although the direct effects of the soybean value chain on the broader U.S. economy are significant, they fail to capture the ripple effect that soy has on supporting industries. These are termed the ***indirect*** effects. For example, the facilities that process soybeans, either through crushing or refining crude into edible oil or biofuels, may employ only 50-100 people directly, but will employ many more on a contractual basis to keep the capital-intensive facility in working order.

Similarly, direct effects fail to capture the economic activity stemming from expenditures of households drawing a salary from a given sector. While these "***induced***" effects are typically smaller than indirect effects, they can still constitute a sizable economic force, particularly in a local economy.

Diagram 28: TOTAL (direct+indirect+induced) BEA economic multipliers used in this study



For this study, we have used the latest, detailed state-level multipliers available through the U.S. Department of Commerce's Bureau of Economic Analysis (BEA). These multipliers are estimated by the BEA for 369 industries using input-output models, which measure the impact to the broader economy as activity ebbs and flows in a specific sector. The national average multipliers used in this study are presented in Diagram 28.

It is important to note that the latest multiplier estimates from BEA, used in this report, estimate slightly lower multiplier effects for employment, economic and wage effects than those utilized in the previous study.