



# Soybean Transportation Profile

AMS Transportation and Marketing Programs

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## Executive Summary

U.S. soybean farmers depend on transportation as the critical link between their fields and markets here and abroad. Since the early 1990s, U.S. soybean farmers have been responding to world demand for more protein feed for the growing meat and poultry sectors in developing economies, especially China. This report examines transportation implications of the recent trends and outlook for U.S. soybeans.

### Key highlights:

- Most U.S. soybeans are grown in the Upper Midwest and the Corn Belt. During the last 10 years, over 40 percent of production was exported on average each year, relying on barge and rail transportation to be shipped to port.
- Domestic demand by the livestock and poultry sectors is serviced by truck and rail.
- The United States is losing its world market share to South America which has lower cost of production, increasing the importance of U.S. transportation efficiency to competitiveness.
- The majority of soybean exports are shipped through the Mississippi Gulf Coast (60 percent of 2013 soybean exports), but when the spread of ocean shipping cost between the Mississippi Gulf Coast and the Pacific Northwest (PNW) exceeds \$30, it generally leads to a greater proportion of Asia-bound soybeans being shipped by rail to ports in the PNW. The ocean rate is the main driver for the choice of port for export, because inland barge transportation to the Mississippi Gulf is usually more efficient and less expensive than rail.

## Introduction

Transportation is an essential part of agricultural marketing. America's soybean farmers depend on an adequate and efficient transportation system to move their crops to market and to bring them inputs such as fertilizer and seed, all of which are usually transported great distances.

Transportation demand is a derived demand because the production and consumption of an agricultural commodity create the demand for transportation services. As such, it is an essential part of marketing; any change in supply of or demand for the underlying commodity can affect the transport system's efficiency by bringing about either shortages or surpluses in transportation capacity. Short-term agricultural transportation demand is influenced by weather-related transportation



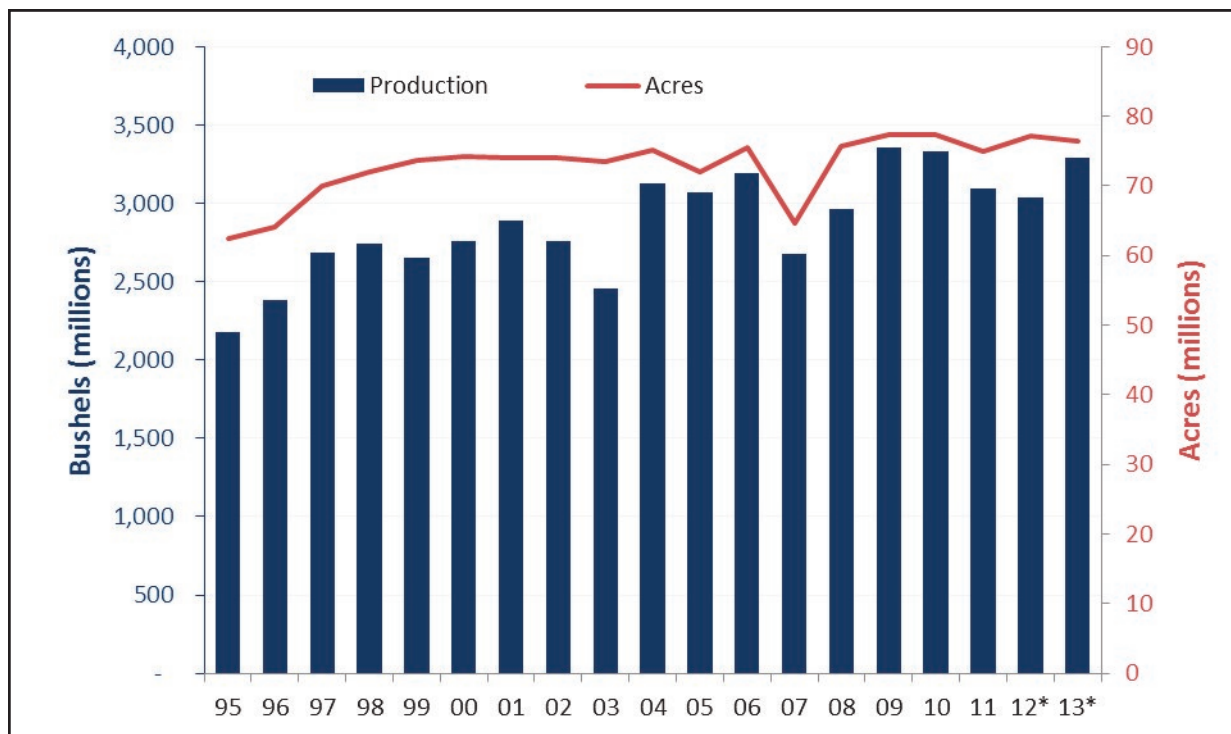
disruptions, variation in annual crop size and location, the timing of planting and harvesting, global trade patterns, crop quality concerns, competition in production by other countries, and commodity price fluctuations. These and other factors can translate into unexpected shifts in transportation patterns and costs, adding to the commodity price risk to be managed by agricultural producers, processors, and shippers.

The United States is the world’s largest soybean producer and until 2012/13, it was the largest soybean exporter. Soybeans comprise about 90 percent of U.S. oilseed production; peanuts, sunflower seed, canola, flax, and other oilseeds make up the remainder.<sup>1</sup> U.S. acreage planted to soybeans trails only that of corn. Soybeans are the primary source of high-protein feed in the world and are also used for biofuel, vegetable oil, and other food products.

### Supply and Demand

Acreage devoted to growing soybeans increased steadily during the 1990s, but growth stabilized during the 2000s with a record high of 77.0 million acres planted in 2009/10 and 2010/11. In Figure 1, production in millions of bushels is indicated by the bars and read from the left axis, while planted acres in millions of acres is shown by the line and read from the right axis. In 2013/14, 76 million planted acres were forecast, the third highest acreage on record, and 3 percent greater than the previous 10-year average of 74.0 million acres. More than 80 percent of U.S. soybean acreage is concentrated in the Upper Midwest, although significant amounts are still planted in the historically important areas of the Delta and Southeast, mostly for local feed use.<sup>2</sup>

**Figure 1: Soybean production and planted acreage, 1995/96 to 2013/14\***



\*Forecast

Note: Years on horizontal axis indicate harvest years; “95” represents the harvest year 1995/1996.

Source: AMS analysis of data from Table 2, USDA/Economic Research Service, Oil Crops Yearbook, March 31, 2014.

1 USDA/Economic Research Service Soybean and Oil Crops Overview. <http://www.ers.usda.gov/topics/crops/soybeans-oil-crops.aspx>. Web page accessed April 2014.

2 USDA/National Agricultural Statistics Service, Soybeans: Planted Acreage by County, Web: <[http://www.nass.usda.gov/Charts\\_and\\_Maps/Crops/County/sb-pl.asp](http://www.nass.usda.gov/Charts_and_Maps/Crops/County/sb-pl.asp)> Web page accessed February 2014.



Over the past decade, soybean production increased marginally and has fluctuated mostly with the acreage planted. USDA's World Agricultural Outlook Board publishes monthly forecasts, which are important to world grain and oilseed merchandisers in price valuation and marketing decisions. For example, during winter of 2014, the timeframe of this analysis, 2013/14 soybean production was forecast to be 3.0 billion bushels, 34 percent higher than 2003/04 production. Soybean production reached a peak 3.4 billion bushels in 2009/10, and the average from 2002/03 to 2012/13 was approximately 3.0 billion bushels.<sup>3</sup>

Soybeans are processed in crushing facilities (thus the term "crush" in table 1) to create two value-added products, meal and oil. Soybean meal is primarily used for high-protein animal feed. Domestic and foreign demand for soybeans is closely tied to the livestock and poultry industry in the United States and abroad. According to Soy Info Center, "a small proportion of soybean meal is used to make defatted soy flour, soy protein concentrates and isolates, and textured soy protein products."<sup>4</sup> Soybean oil can be further processed after crushing into cooking oil or left unprocessed and used in the production of biodiesel.<sup>5</sup> The United States is the world's second largest exporter of soybeans after Brazil, with exports accounting for an average of 41 percent of total use from 2004 to 2013 (see table 1).<sup>6</sup>

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3 USDA/Economic Research Service Soybean and Oil Crops Overview. <http://www.ers.usda.gov/topics/crops/soybeans-oil-crops.aspx>. Web page accessed April 2014. USDA/Economic Research (ERS): Oil Crops Yearbook, Table 2.

4 Soy Info Center. <[http://www.soyinfocenter.com/HSS/soybean\\_crushing1.php](http://www.soyinfocenter.com/HSS/soybean_crushing1.php)>. Web page accessed August 2014.

5 How the Global Oilseed and Grain Trade Works. U.S. Soybean Export Council, with Soyatech and HighQuest Partners, April 2012.

6 USDA/Economic Research Service soybean yearbook tables, 2014, <<http://www.ers.usda.gov/data-products/oil-crops-yearbook.aspx>>. Web page accessed May 2014.

**Table 1: United States soybean supply and demand, 1995 to 2013**

Year	Supply			Use					
	Beginning Stocks	Production	Total Supply	Crush	Exports	Seed, Feed and Residual	Total Use	Ending Stocks	Ending Stocks/Use
— Million Bushels —									
1995/96	335	2,174	2,514	1,370	849	111	2,330	183	8%
1996/97	183	2,380	2,573	1,436	886	119	2,441	132	5%
1997/98	132	2,689	2,826	1,597	874	155	2,626	200	8%
1998/99	200	2,741	2,944	1,590	805	201	2,596	348	13%
1999/00	348	2,654	3,006	1,578	973	165	2,716	290	11%
2000/01	290	2,758	3,052	1,640	996	168	2,804	248	9%
2001/02	248	2,891	3,141	1,700	1,064	169	2,933	208	7%
2002/03	208	2,756	2,969	1,615	1,044	131	2,791	178	6%
2003/04	178	2,454	2,638	1,530	887	109	2,525	112	4%
2004/05	112	3,124	3,242	1,696	1,097	193	2,986	256	9%
2005/06	256	3,068	3,327	1,739	940	199	2,878	449	16%
2006/07	449	3,197	3,655	1,808	1,116	157	3,081	574	19%
2007/08	574	2,677	3,261	1,803	1,159	94	3,056	205	7%
2008/09	205	2,967	3,185	1,662	1,279	106	3,047	138	5%
2009/10	138	3,359	3,512	1,752	1,499	110	3,361	151	4%
2010/11	151	3,329	3,495	1,648	1,501	130	3,280	215	7%
2011/12	215	3,094	3,325	1,703	1,365	88	3,155	169	5%
2012/13*	169	3,034	3,239	1,689	1,320	90	3,099	141	5%
2013/14*	141	3,289	3,454	1,700	1,495	109	3,304	150	5%

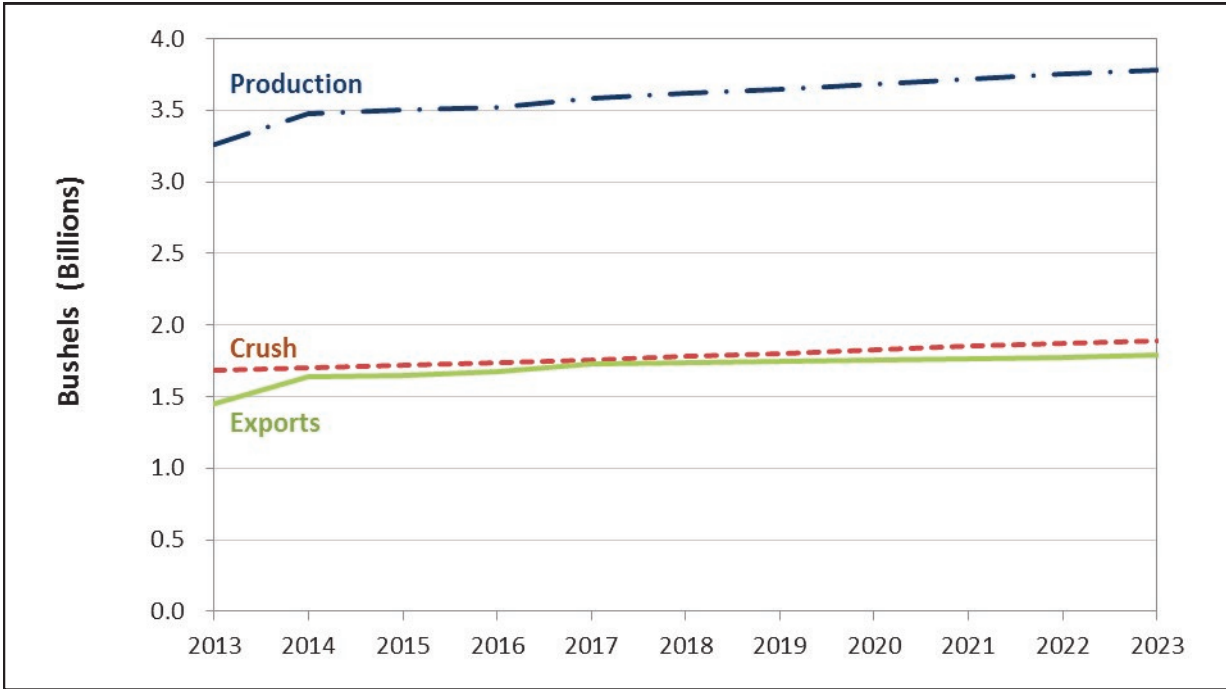
\*Forecast

Source: USDA/Economic Research Service soybean yearbook tables, 2014



According to USDA long-term projections to 2023, U.S. soybean production is expected to grow gradually over the next decade (see figure 2).<sup>7</sup> The crush demand for high-protein soybean feed by the domestic livestock and poultry sectors, and demand for soybean oil, is expected to increase slightly, offsetting the expectation of almost no growth in exports. Long-term projections do not take into account annual fluctuations in supply and demand, but if these long-term projections materialize, then transportation demand for moving soybeans would have a greater impact on the trucking sector, as trucks are the primary mode for moving soybeans to domestic markets (see Soybean Modal Shares section.)

**Figure 2: U.S. soybean production and use projections, 2013 to 2023**



Source: USDA/Office of the Chief Economist agricultural projections to 2023, February 2014 .

### Transportation Implications

U.S. soybean production is concentrated in the Midwest. In 2013, the largest soybean-growing States were Illinois, Iowa, Minnesota, Indiana, Nebraska, and Ohio, each of which produced over 200 million bushels. Together, these six States accounted for 57 percent of U.S. soybean production.<sup>8</sup>

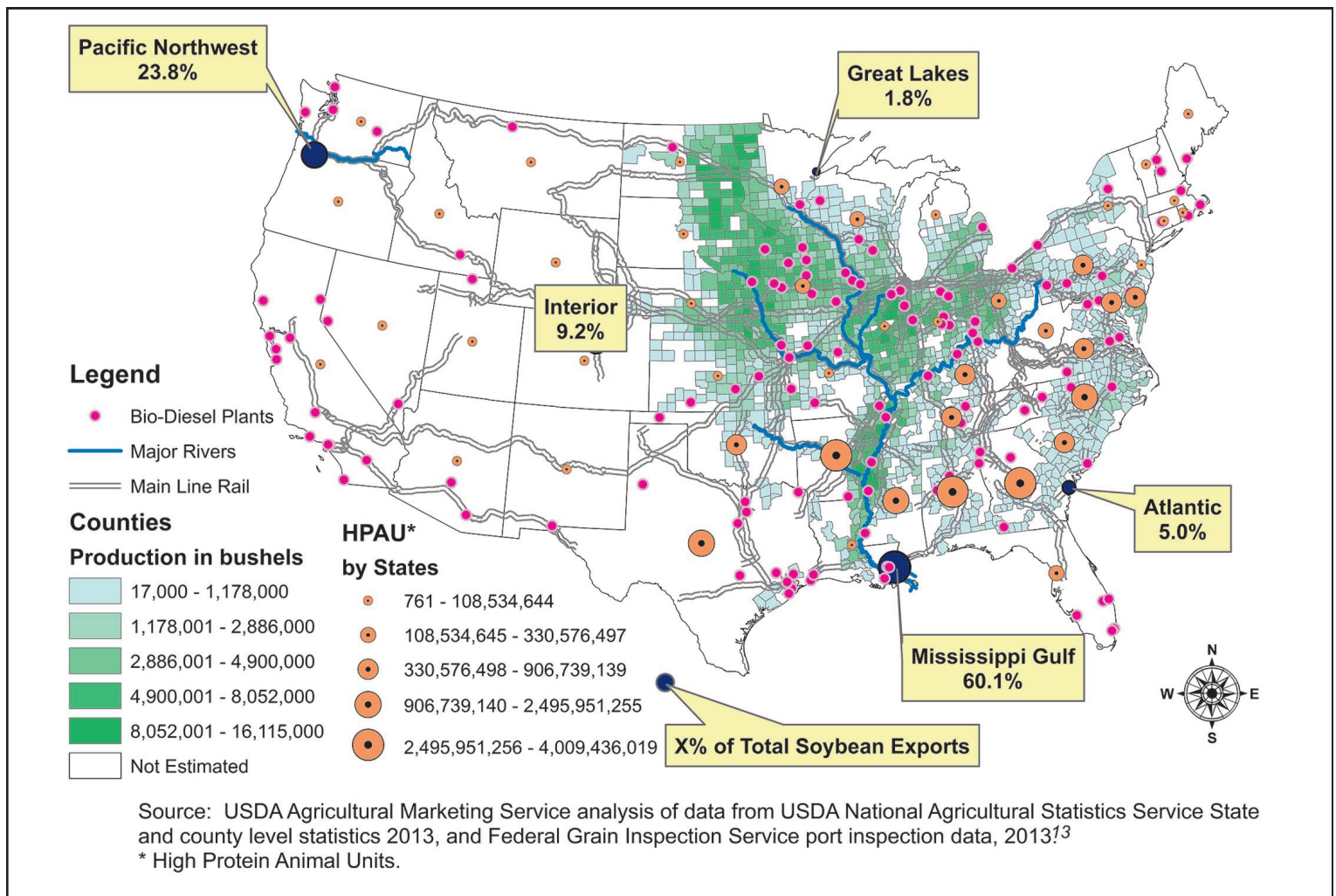
Because of their importance as a source of protein in feed, soybeans are shipped from the growing regions in the Upper Midwest and the Corn Belt to areas with crushing facilities and areas of concentrated pork and poultry operations, which are located in the South and Southeast. About 45 percent of U.S. soybean production is exported. It is moved to major ports for export—mostly via barge to the Mississippi Gulf and rail to the Pacific Northwest.<sup>10</sup> An efficient and effective transportation

7 USDA/Weekly Weather and Crop Bulletin Agricultural Long-term Projections to 2023, February 2014. <http://www.ers.usda.gov/topics/crops/corn/background.aspx>  
8 USDA/National Agricultural Statistics Service State-level production statistics, 2001-2013.  
9 Top 5 States in the South and Southeast with high protein consuming animal units include: Georgia, Arkansas, Alabama, North Carolina, and Mississippi. These five States have 10 of the 93 crushing facilities.  
10 USDA 2007 Census of Agriculture, county-level animal inventories.



network is important for U.S. soybean growers to maintain a competitive edge in the world market. Figure 3 shows the relationship between the soybean producing region and areas of feed demand, export locations, and biodiesel production facilities. Biodiesel production facilities, unlike ethanol biorefineries, are not concentrated in one particular region, making transportation of feedstocks more complex. Feedstocks for production of biodiesel are made from an increasingly diverse mix of resources including agricultural oils, recycled cooking oil, and animal fats, possibly explaining the dispersed location of biodiesel refineries.<sup>11</sup> Most soybeans used domestically are moved from growing regions to nearby crushing facilities by truck. In 2011, there were 93 soybean crushing facilities in the United States, with almost 67 (over 70 percent) of them located in the soybean growing States, with the highest concentration in Iowa (17), Illinois (12), Minnesota (8), and Indiana (7).<sup>12</sup> The waterways and main rail lines in Figure 3 demonstrate the critical links between farmers and their markets.

**Figure 3: 2013 Soybean production by county, bio-diesel plants, export port regions, and HPAU\* by State**



11 National Biodiesel Board. <<http://www.biodiesel.org/>>. Web page accessed August 2014.

12 Soyatech. <[http://www.soyatech.com/bluebook\\_ref/references/UScrushers.pdf](http://www.soyatech.com/bluebook_ref/references/UScrushers.pdf)>. Web page accessed August 2014.

13 USDA/Grain Inspection, Packers and Stockyards Administration Interior land-based inspections of grain are conducted at several inland locations throughout the United States. USDA/AMS *Grain Transportation Report*. June 6, 2013.



## Soybean Modal Shares

From 2002 to 2011, soybeans accounted for 19 percent of U.S. grain moved by all modes of inland transportation (truck, barge, and rail). The large majority of soybeans used domestically were carried by truck (see table 2). From 2002 to 2011, 85 percent of domestic soybean transportation was by trucks, 13 percent was by rail, and 3 percent by barge. Because trucks are used to move soybeans to crush facilities, it is not surprising that trucks have a high modal share.

**Table 2: Soybean modal shares, 2002 to 2011**

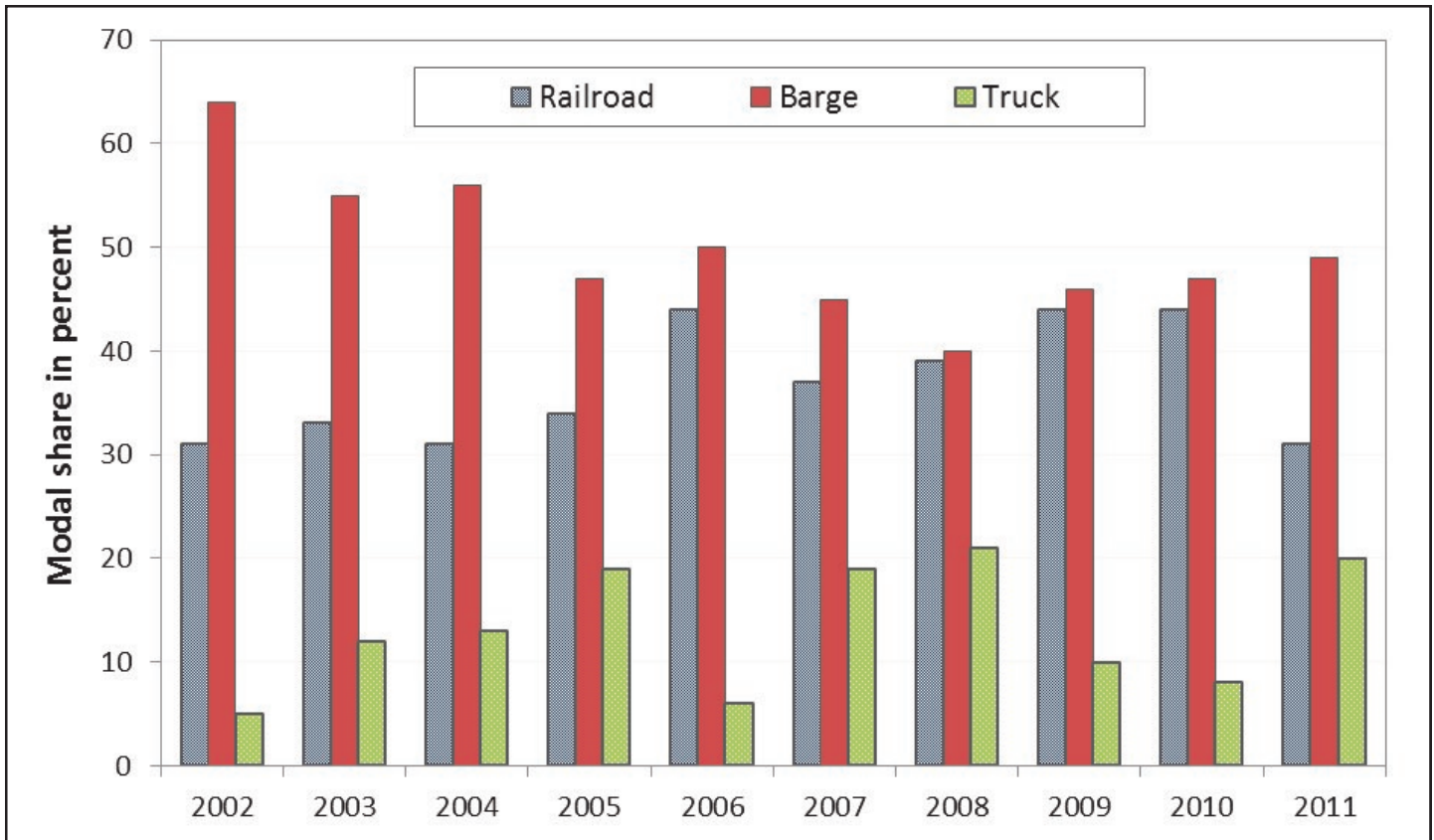
Year & Type of Movement	Rail		Barge		Truck	
	1,000 Tons	Percent	1,000 Tons	Percent	1,000 Tons	Percent
<b>Total</b>						
2002	16,550	19	21,399	25	47,405	56
2003	17,735	21	20,167	24	47,047	55
2004	15,029	21	17,053	24	40,449	56
2005	16,141	20	16,332	20	49,878	61
2006	19,862	24	16,221	19	47,521	57
2007	19,478	23	16,327	19	48,388	57
2008	20,899	23	16,326	18	51,931	58
2009	25,745	26	21,569	22	50,413	52
2010	26,778	26	23,472	23	51,439	51
2011	19,055	21	19,962	22	50,156	56
<b>Average</b>	19,727	22	18,883	22	48,463	56
<b>Export</b>						
2002	9,477	31	19,642	64	1,387	5
2003	11,270	33	18,632	55	4,245	12
2004	8,496	31	15,412	56	3,578	13
2005	10,676	34	15,030	47	5,956	19
2006	13,541	44	15,240	50	1,725	6
2007	12,524	37	15,242	45	6,381	19
2008	14,492	39	15,089	40	7,757	21
2009	19,694	44	20,634	46	4,288	10
2010	20,484	44	21,864	47	3,895	8
2011	12,041	31	18,793	49	7,627	20
<b>Average</b>	13,270	37	17,558	50	4,684	13
<b>Domestic</b>						
2002	7,072	13	1,758	3	46,018	84
2003	6,465	13	1,535	3	42,802	84
2004	6,533	15	1,641	4	36,872	82
2005	5,465	11	1,302	3	43,922	87
2006	6,321	12	982	2	45,795	86
2007	6,953	14	1,086	2	42,007	84
2008	6,407	12	1,237	2	44,174	85
2009	6,051	11	936	2	46,125	87
2010	6,294	11	1,608	3	47,544	86
2011	7,015	14	1,169	2	42,529	84
<b>Average</b>	6,458	13	1,325	3	43,779	85

Source: USDA/Agricultural Marketing Service, *Transportation of U.S. Grains: A Modal Share Analysis, 1978-2011 Update*



Exports, which flow through coastal ports and border crossings far from areas of soybean production, are delivered to those ports primarily by barge and rail (see figure 4). In 2002, 64 percent of soybean exports were carried by barge and 31 percent were delivered by rail. Since that time, the modal share of rail has increased. During 2011, 31 percent of export-bound soybeans were shipped by rail and 49 percent by barge. Twenty percent of soybean exports were transported by trucks during 2011.<sup>14</sup>

**Figure 4: Modal shares of soybean exports, 2002 to 2011**



Source: USDA/Agricultural Marketing Service, *Transportation of U.S. Grains: A Modal Share Analysis, 1978-2011 Update*.

### Transportation Underlies U.S. Competitiveness

An efficient transportation network is one of the key elements for U.S. soybean growers to remain competitive in the world market as foreign competition in export markets continues to strengthen. Continued economic and population growth around the world is expected to increase demand for vegetable oils and protein meal for animal feed. The world soybean trade is projected to increase 40 million tons (36 percent) over the next 10 years, with Brazil firmly taking the lead as the world's major soybean exporter.<sup>15</sup> Prior to 2012/2013, the United States had been the world's leading soybean exporter. U.S. transportation infrastructure plays a major role in keeping U.S. soybeans competitive in world markets.<sup>16</sup>

14 USDA/Agricultural Marketing Service, *Transportation of U.S. Grains: A Modal Share Analysis, 1978-2011 Update*, 2013. <<http://dx.doi.org/10.9752/TS049.05-2013>>.

15 USDA/World Agricultural Outlook Board Agricultural Long-term Projections to 2023, February 2014.

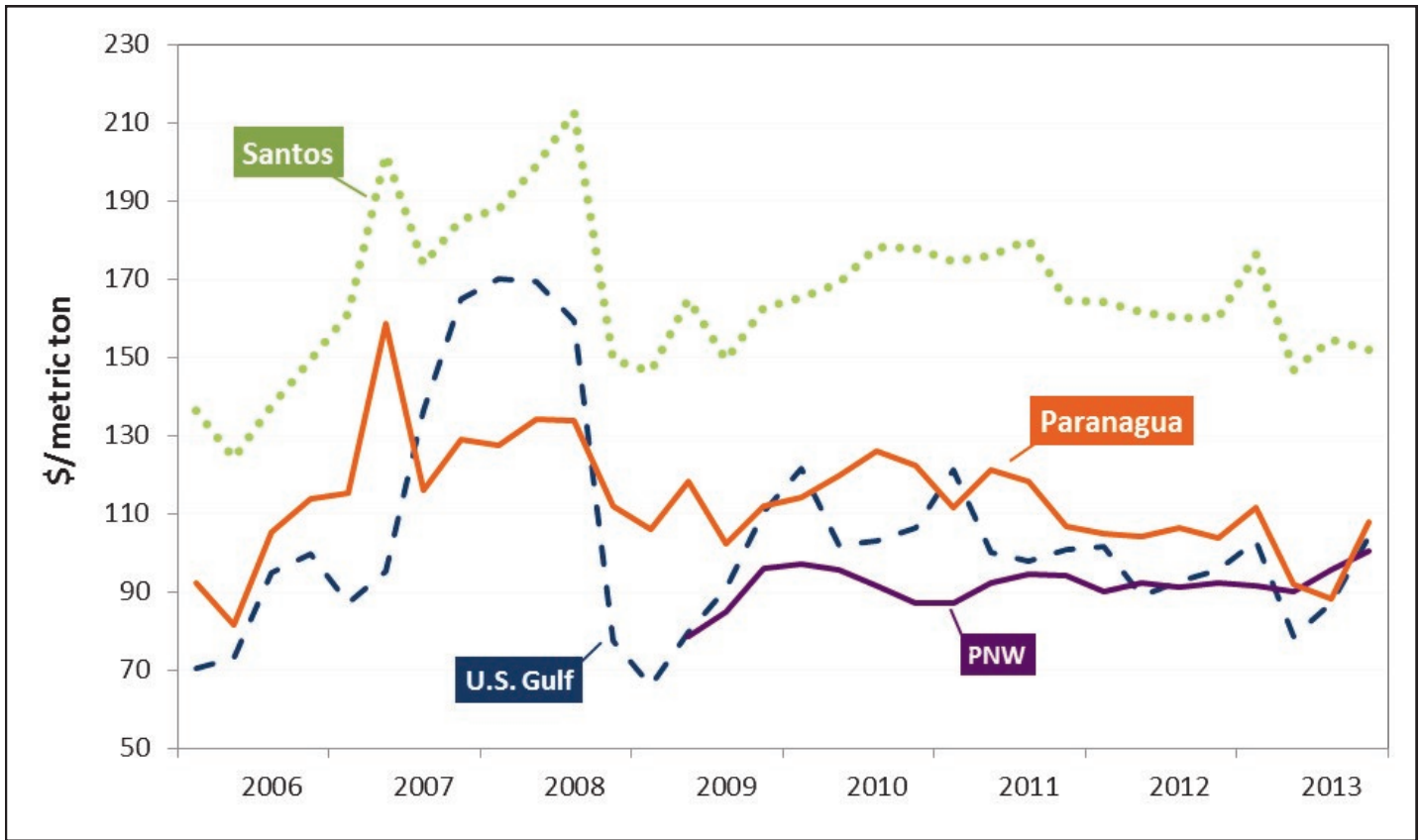
16 Salin, Delmy L., USDA, Agricultural Marketing Service, *Soybean Transportation Guide: Brazil 2013*, June 2014.





Argentina, Brazil, and the United States account for about 85 percent of total soybean, soybean meal, and soybean oil exports. Yet U.S. exporters are able to remain competitive against lower foreign production costs because of the United States' advantage in domestic and transoceanic transportation. Figure 5 shows the relationship between the United States and Brazil transportation costs for shipping soybeans from domestic production regions to China, including ocean shipping rates. U.S. transportation costs via two routes (U.S. Gulf and PNW) are consistently much lower than Brazil's transportation costs of shipping soybeans from North Mato Grosso through Santos. The United States has also generally had an advantage over Brazil's costs of shipping soybeans from South Goias through Paranagua to China.

**Figure 5: U.S. versus Brazil soybean transportation costs to Shanghai, China**



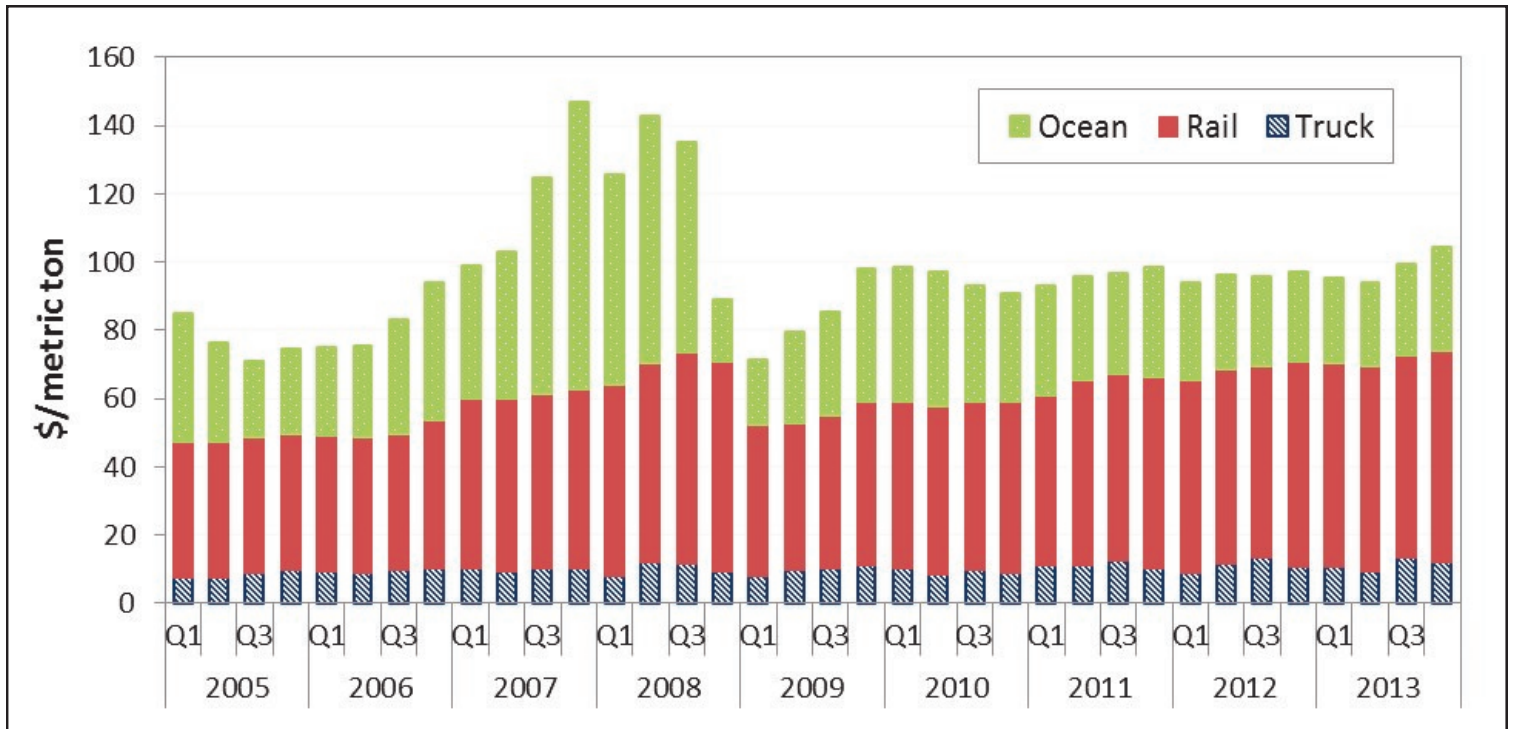
**U.S. Gulf:** From Minneapolis, MN; **Pacific Northwest (PNW):** From Fargo, ND, through the Pacific Northwest; consistent data available only since 2009; **Santos:** From North Mato Grosso, Brazil; **Paranagua:** From South Goias, Brazil  
 Source: Salin, Delmy L., USDA/Agricultural Marketing Service, Soybean Transportation Guide: Brazil 2013, June 2014.

Figure 6 shows the costs by mode of transportation (truck, rail, and ocean) of shipping soybeans from Minnesota to Japan through the Pacific Northwest from the first quarter (Q1) 2005 to Q4 2013. Total transportation costs averaged \$96.3/metric ton (mt) over the period, with prices spiking from Q3 2007 to Q3 2008. The rise in prices was mostly due to increases in ocean shipping rates, which rose from \$38.85/mt in Q1 2007 to \$84.2/mt in Q4 2007 and spiked in 2008 because of higher diesel fuel prices and an increase in bulk shipping demand due to massive infrastructure development by China in preparation for the 2008 Summer Olympics. Since 2009, the Gulf-to-Japan ocean rates have been relatively stable. In general, fuel prices, port congestion, and global demand for bulk ocean services can all contribute to higher ocean transportation costs. Figure 7 shows the spread (difference) in total transportation costs between shipping through the Mississippi Gulf and the Pacific Northwest. From Q1 2005 to Q4 2013, shipping through the Gulf was, on average, \$4.46/mt more expensive.<sup>17</sup>

17 USDA/Agricultural Marketing Service Transportation Services Division Grain Cost Estimators, 2012.



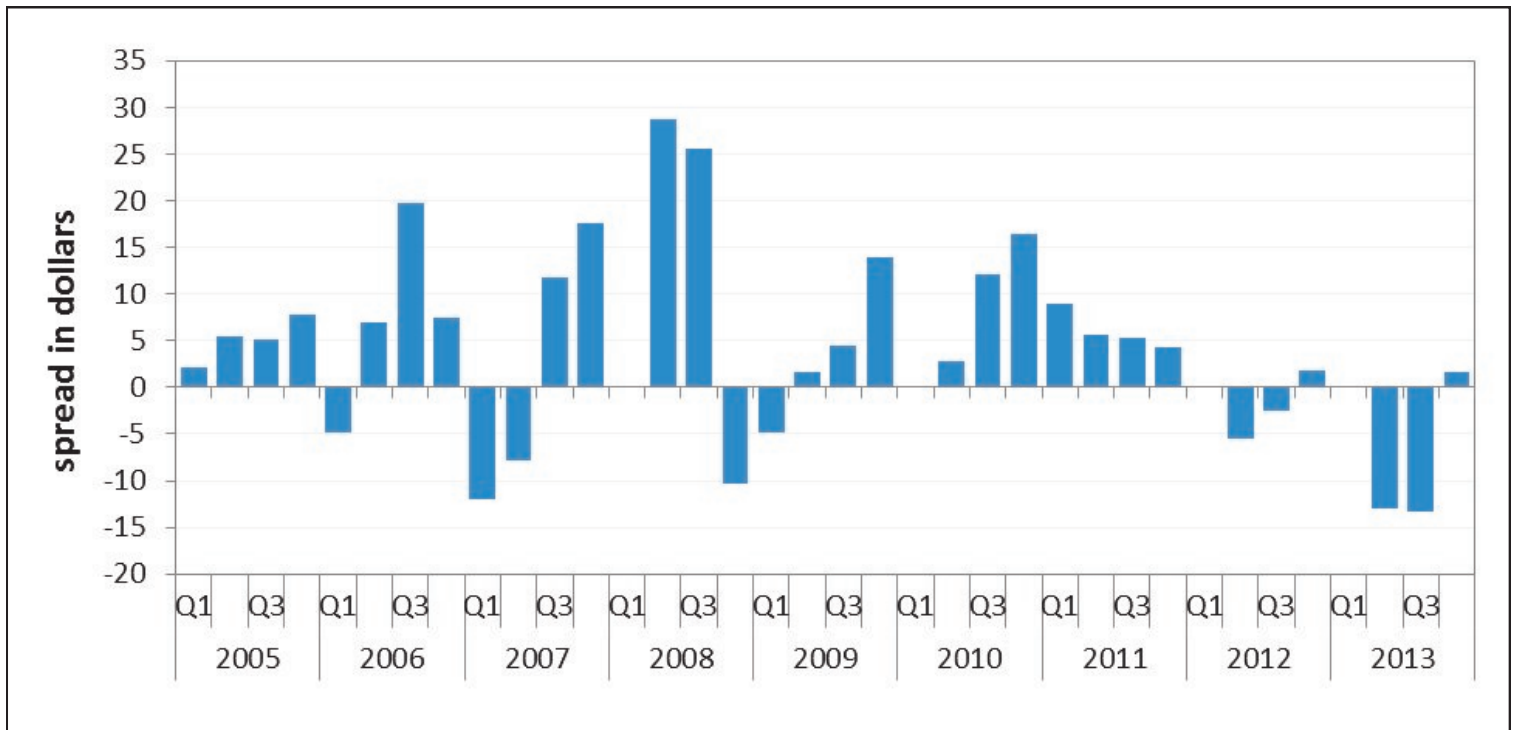
**Figure 6: Transportation costs for soybean exports, Minnesota to Japan via PNW, 2005 to 2013**



Q=quarter

Source: USDA/Agricultural Marketing Service, Transportation Services Division, Transportation costs for major grains, 2013.

**Figure 7: Spread of total soybean transportation costs between Gulf to Japan and Pacific Northwest (PNW) to Japan (Gulf total costs minus PNW total costs), 2005 to 2013**



Q=quarter

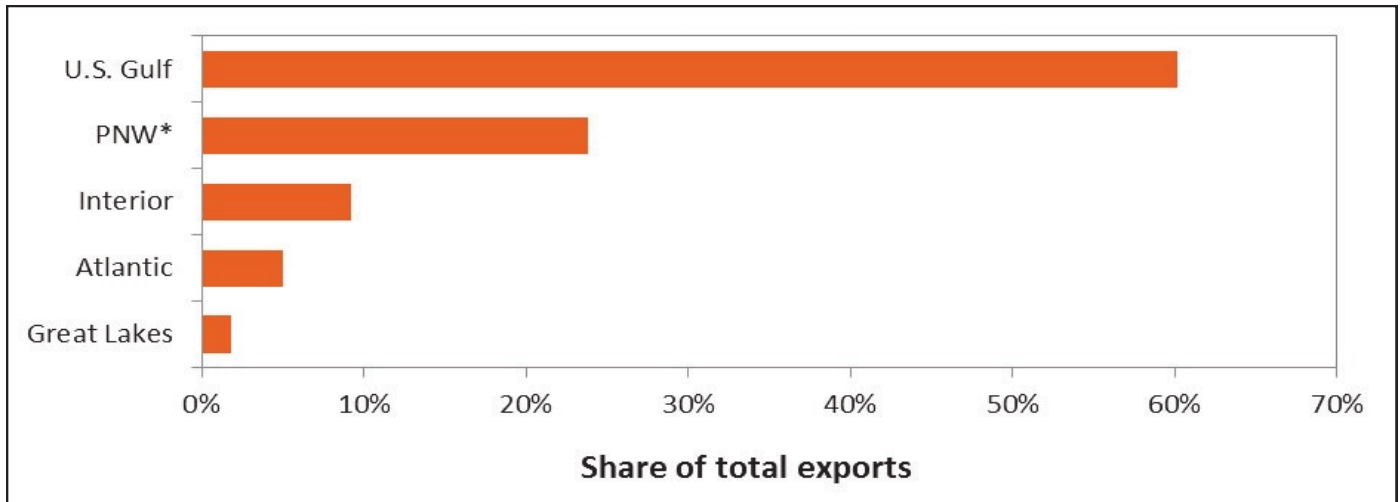
Source: USDA/Agricultural Marketing Service, Transportation Services Division, Transportation costs for major grains, 2014.



## Soybean Exports

The majority of soybean exports are shipped through the Mississippi Gulf region—60 percent in 2013 (see figure 8). Another 24 percent was shipped through the Pacific Northwest while the remainder was shipped through other ports.<sup>18</sup>

**Figure 8: U.S. soybean exports by port region, 2013**

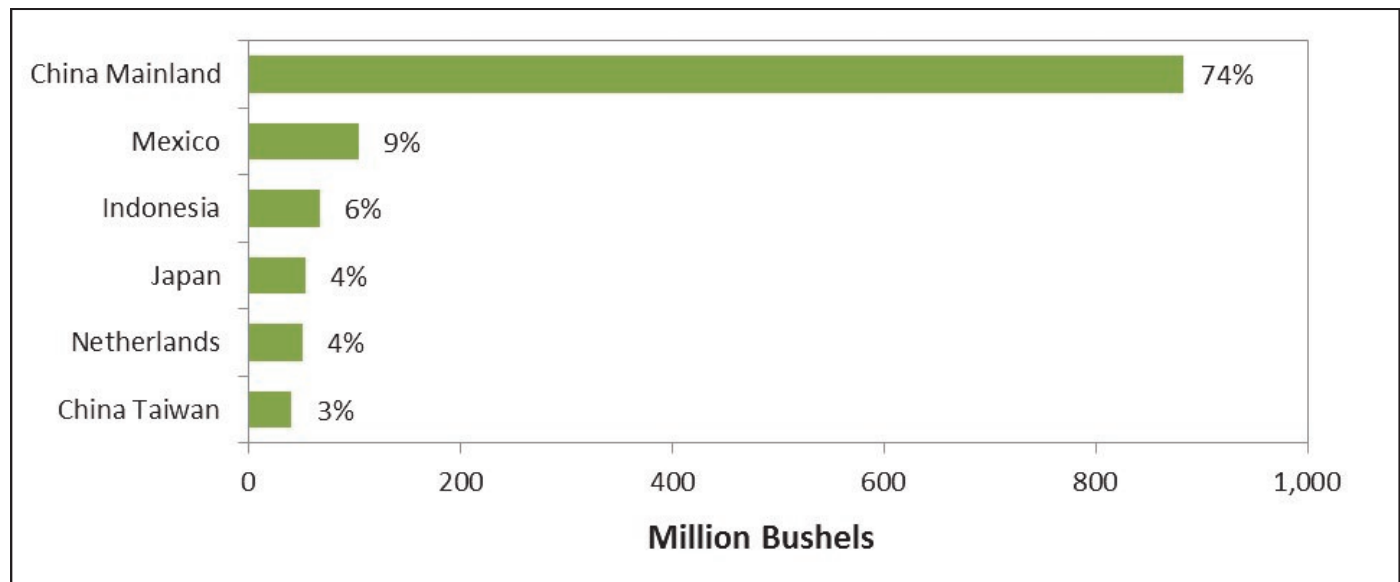


\*Pacific Northwest

Source: USDA/Federal Grain Inspection Service grain inspections 2014.

In 2013, the top five destinations for American soybeans were, in order, China, Mexico, Indonesia, Japan, and the Netherlands. Together, these five countries accounted for 82 percent of all U.S. soybean exports. Figure 9 shows the amount exported to each of these five countries and their share of the total.

**Figure 9: Soybean exports by destination country, 2013**

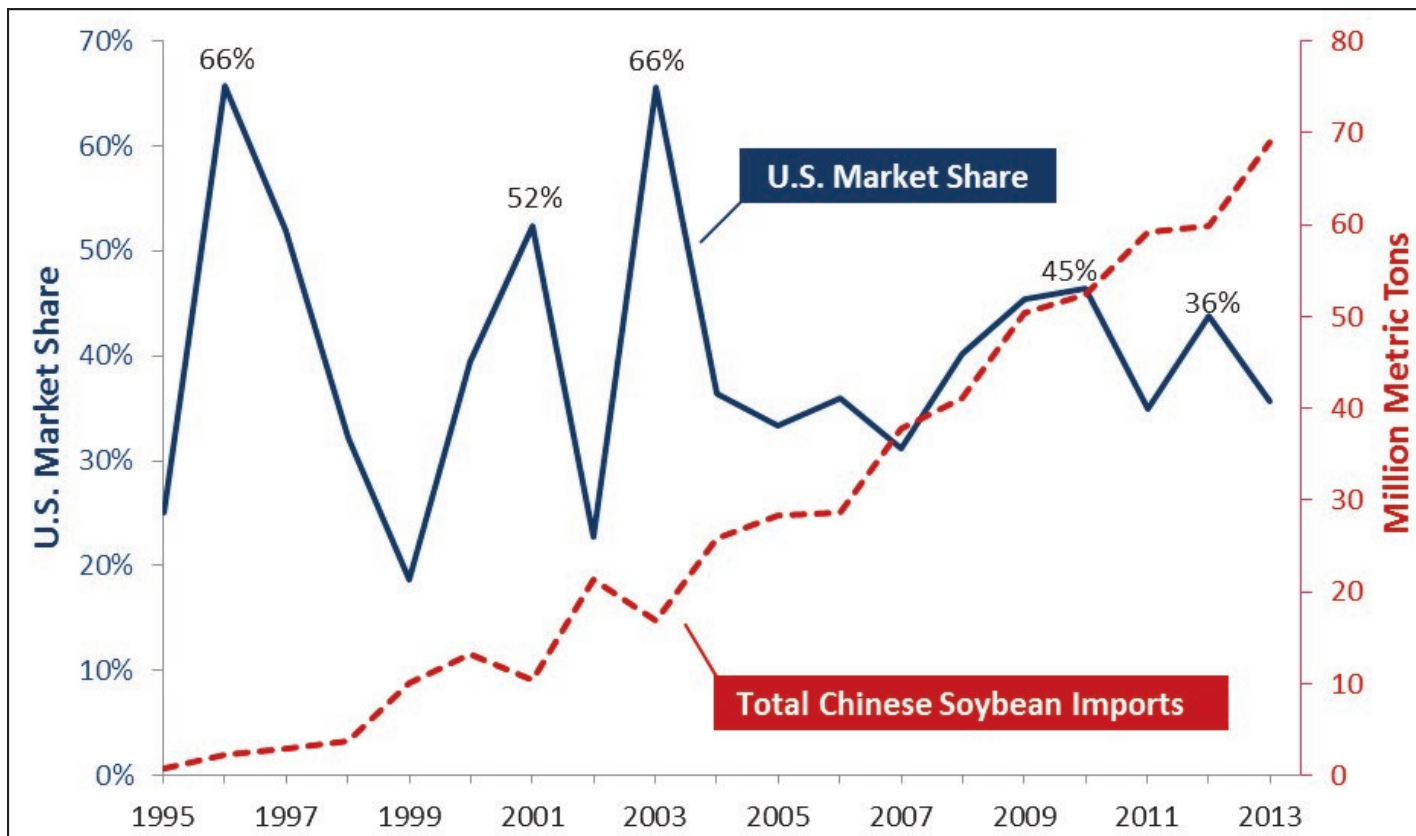


Source: USDA/Federal Grain Inspection Service grain inspections 2014.



Figure 10 shows the increase in China’s soybean imports in million metric tons since 1995 on the right vertical axis. The U.S. market share of the Chinese soybean imports, shown in percentage on the left vertical axis, fluctuated in the 1990s, reaching a peak of 66 percent of all soybeans imported by China in 2003/04. Since then, the average U.S. market share has ranged from 30 to 45 percent of total soybean imports by China, with the rest of the soybean imports fulfilled with South American soybeans, especially from Brazil as it became the leading soybean exporter in 2012/13.

**Figure 10: U.S. market share of Chinese soybean imports**



Source: USDA/Agricultural Marketing Service Analysis of USDA/Foreign Agricultural Service data.

## Conclusion

Growth in demand for U.S. soybeans over the past 10 years occurred mostly in Asia, especially mainland China. Over the next 10 years, however, USDA projects that most of the growth in demand for U.S. soybeans will occur in the domestic demand categories. Domestic soybean processors will continue to rely on efficient truck transportation, creating the need for continued investment in highway and bridge infrastructure to support intra- and inter-State commerce. To remain competitive with Brazil, which is investing heavily in its transportation infrastructure, U.S. rail and barge transportation must remain competitive for U.S. soybeans to continue to compete with the lower-cost-of-production soybeans from South America.



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1. USDA Economic Research Service (ERS). Soybean Yearbook Tables: <<http://www.ers.usda.gov/data-products/oil-crops-yearbook.aspx>>
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4. USDA/Agricultural Marketing Service, *Transportation of U.S. Grains: A Modal Share Analysis*, May 2013. Web. <<http://dx.doi.org/10.9752/TS049.05-2013>>

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