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Wacky Weather:

What Do El Niño and La Niña Mean for Crop Production?

AgriThought

AgriBank Farm Credit Bank provides financial solutions to meet the needs of production agriculture in America's heartland. We feature our research and analysis in AgriBank Insights as part of our AgriThought initiative to help inform the financial decisions among those we serve.

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During prior El Niño-to-La Niña periods, crop prices tended to spike in reaction to lower yields. For 2016, however, the normally favorable transition year most likely won't offset current pricing headwinds, such as recent domestic bumper crops, ample worldwide corn and soybean stocks, and a strong U.S. dollar that hinders exports.

Highlights

- **EL NIÑO BRINGS WIDESPREAD PRECIPITATION.** Current El Niño weather patterns have joggled a bit further north than normal. This has delivered more widespread – and in some cases, unexpected – wet weather across the country.
- **LA NIÑA TO FOLLOW WITH WARMER, DRIER CONDITIONS.** As El Niño gradually gives way to an expected La Niña event later this year, temperatures from May through July are forecast to remain above normal, while precipitation is forecast to be below average for much of the eastern part of the District, with southern Michigan, northern Indiana and all of Ohio having the strongest odds for drier conditions.
- **NEGLIBLE IMPACT ON COMMODITY PRICES.** While the El Niño weather pattern will likely persist through the spring, it has yet to materially affect price futures on grains and oilseeds. Taken as a whole, this scenario does not support any strong upward price moves for the upcoming season.

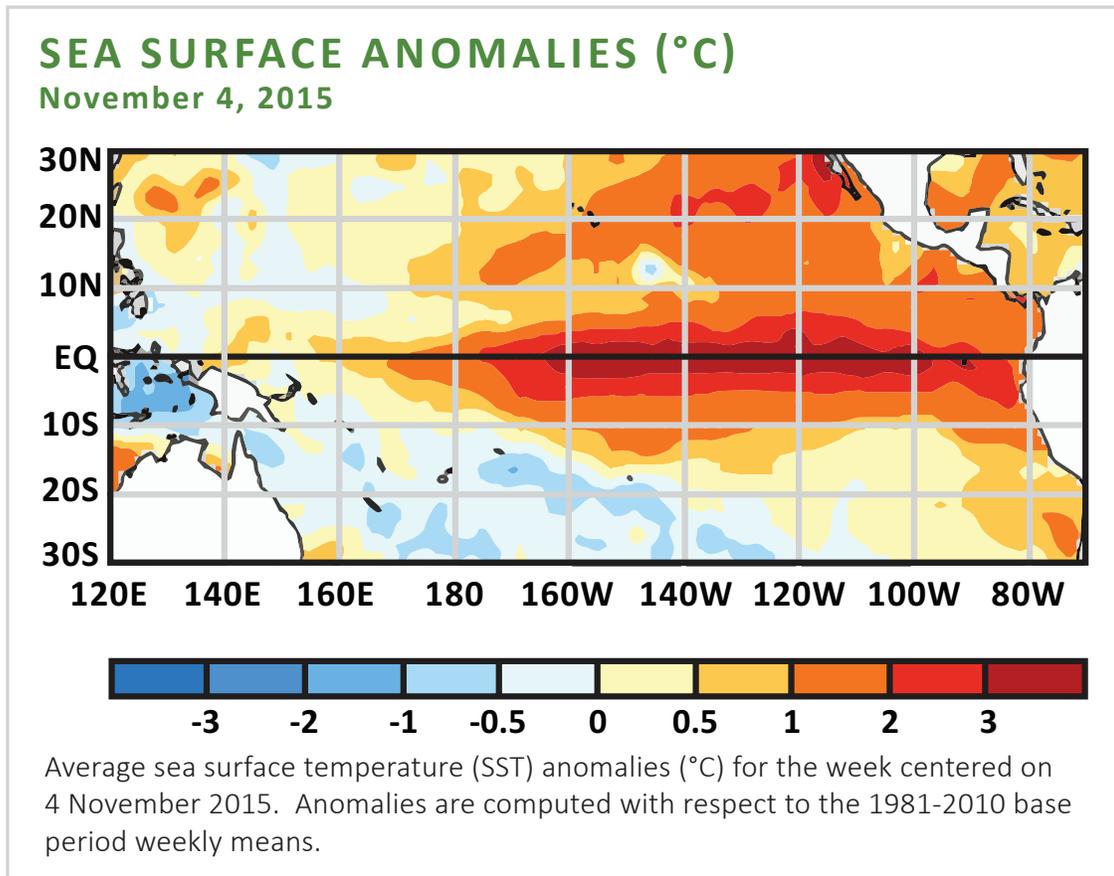


Figure 1

Source: National Integrated Drought Information System

Boosted by great meteorological expectations about its strength, the most recent El Niño event was widely chronicled by media organizations as early as summer 2015, largely due to its potentially dramatic effects on U.S. weather. This recurring climate phenomenon, otherwise known as ENSO (El Niño-Southern Oscillation), is characterized by rising sea-surface temperatures, generally in the equatorial latitudes of the central and eastern Pacific Ocean.¹ According to the National Oceanic and Atmospheric Administration (NOAA), those surface temperatures peaked in November 2015 at approximately 2.3 C above the average Oceanic Niño Index (ONI). This mirrored the ENSO event of 1997-98 as one of the strongest on record (see Figure 1).²



Due to the increase in ocean temperatures, ENSO events tend to shift the jet stream to a more southerly track during winter. Typically, this results in wetter conditions for California and the southern United States, while the Pacific Northwest, Northern Plains, Midwest, and northeastern U.S. generally enjoy a warmer and drier winter season (see Figure 2)

TYPICAL EL NIÑO WINTERS

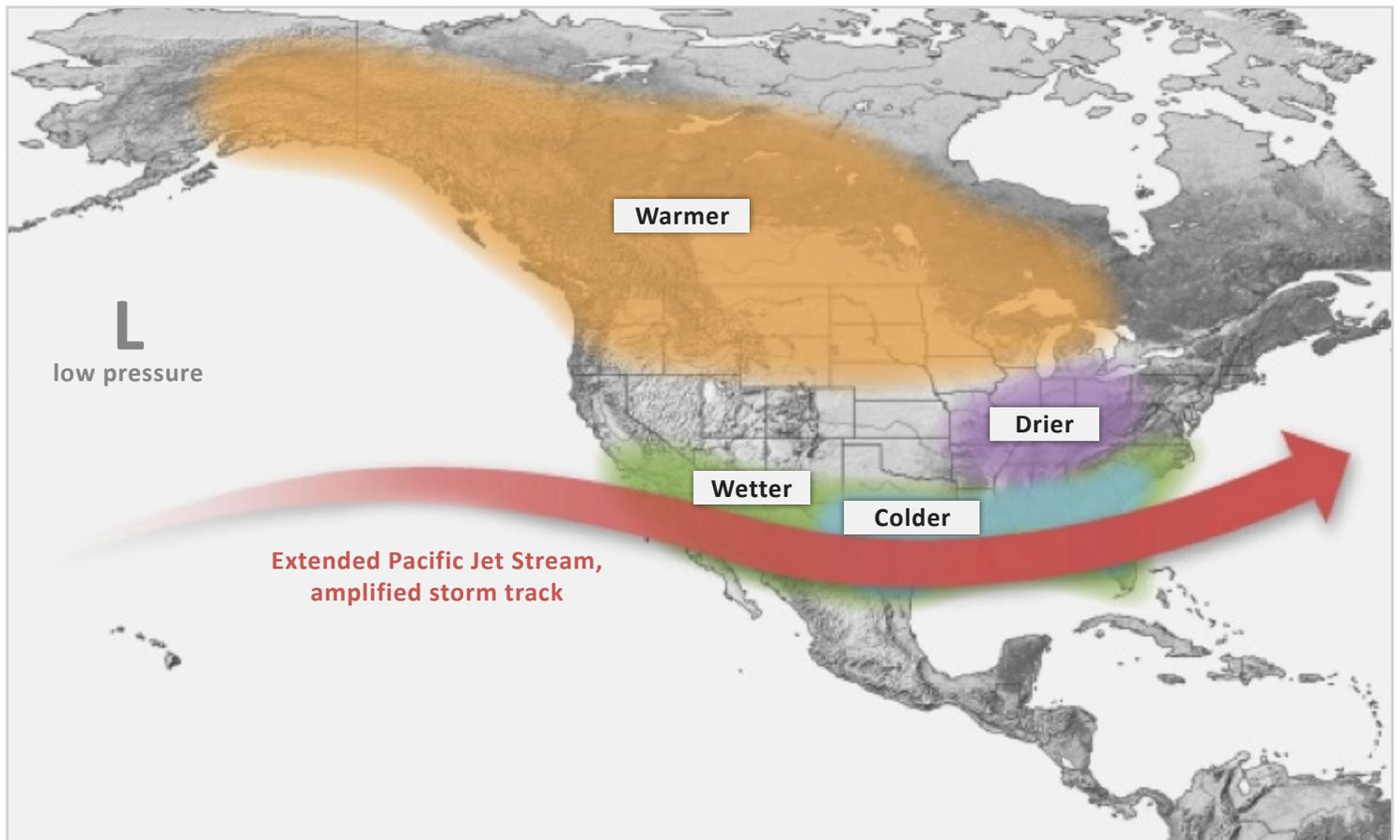
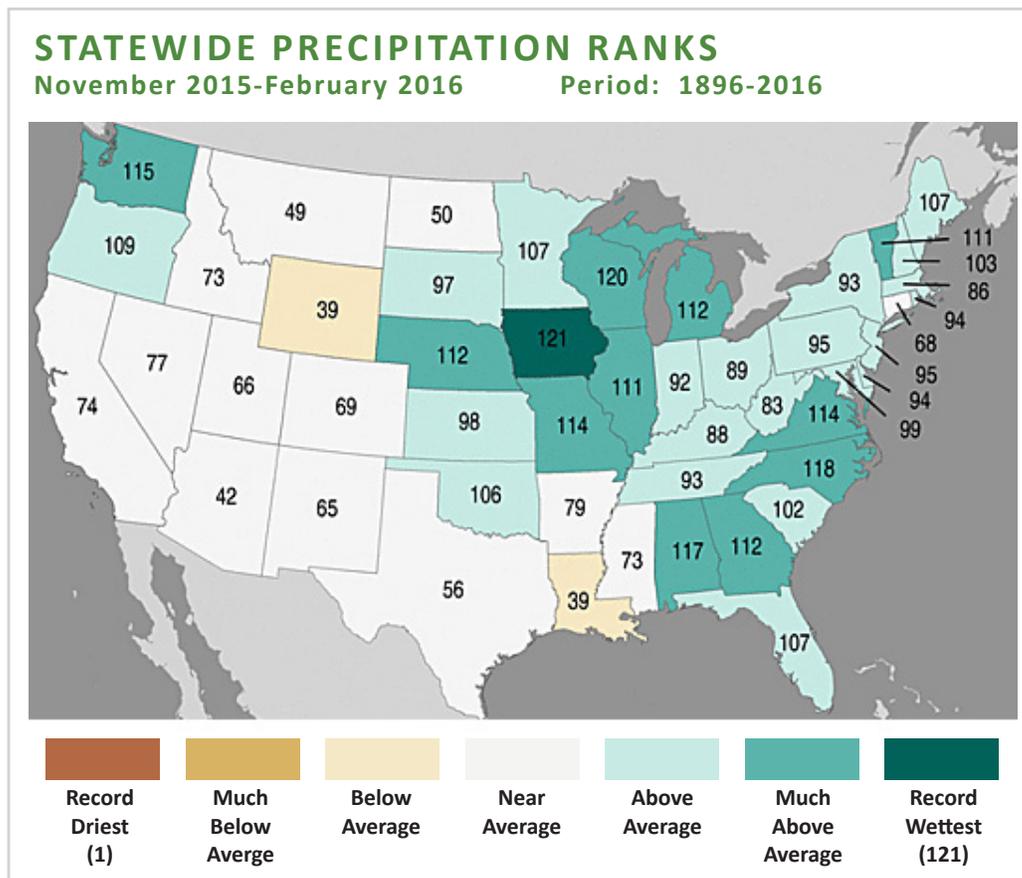


Figure 2

Source: NOAAClimate.gov

The current ENSO event, however, has jogged a bit further north than normal. This has delivered more widespread – and in some cases, unexpected – wet weather across the country. Consider:

- The Pacific Northwest was pounded over the winter of 2015-16, with Seattle receiving over 38 inches of rain to post its wettest cool season on record.³
- While California received heavy rains early and late in the winter cycle, overall rainfall has been below expectations. In fact, the best ENSO hope for the drought-stricken state may well be the accumulating snowpack in the Sierra Nevada Mountains. However, despite the potent ENSO cycle, mountain snows had reached only 78 percent to 87 percent of normal in early March,⁴ which may not provide enough meltwater to adequately refill the state’s dwindling reservoir supplies.
- While the Midwest has met the typical ENSO projection of being warmer than average this past winter, much of the region has received much higher than expected precipitation. In fact, a broad swath of Iowa and southwest Wisconsin had record precipitation from December 2015 through February 2016, and sections of eastern Nebraska, central Missouri, central Illinois and northern Michigan were well above average (see Figure 3).



Looking ahead, NOAA forecasts that seasonal temperatures for most of the 15-state AgriBank District will remain above normal through April, except for extreme southern Illinois and southern Missouri, where temperatures are expected to fall in the normal range. Meanwhile, forecasters believe the ENSO precipitation pattern will shift a bit east, with eastern Wisconsin, northern Indiana, northwestern Ohio and all of Michigan having the best chance for above-normal moisture.⁵ By early summer, ENSO’s effect on U.S. weather is expected to subside, which is consistent with the typical nine- to 12-month duration for this climate phenomenon.

Figure 3

Source: NOAA

Is La Niña Right Around the Corner?

TYPICAL LA NIÑA WINTERS

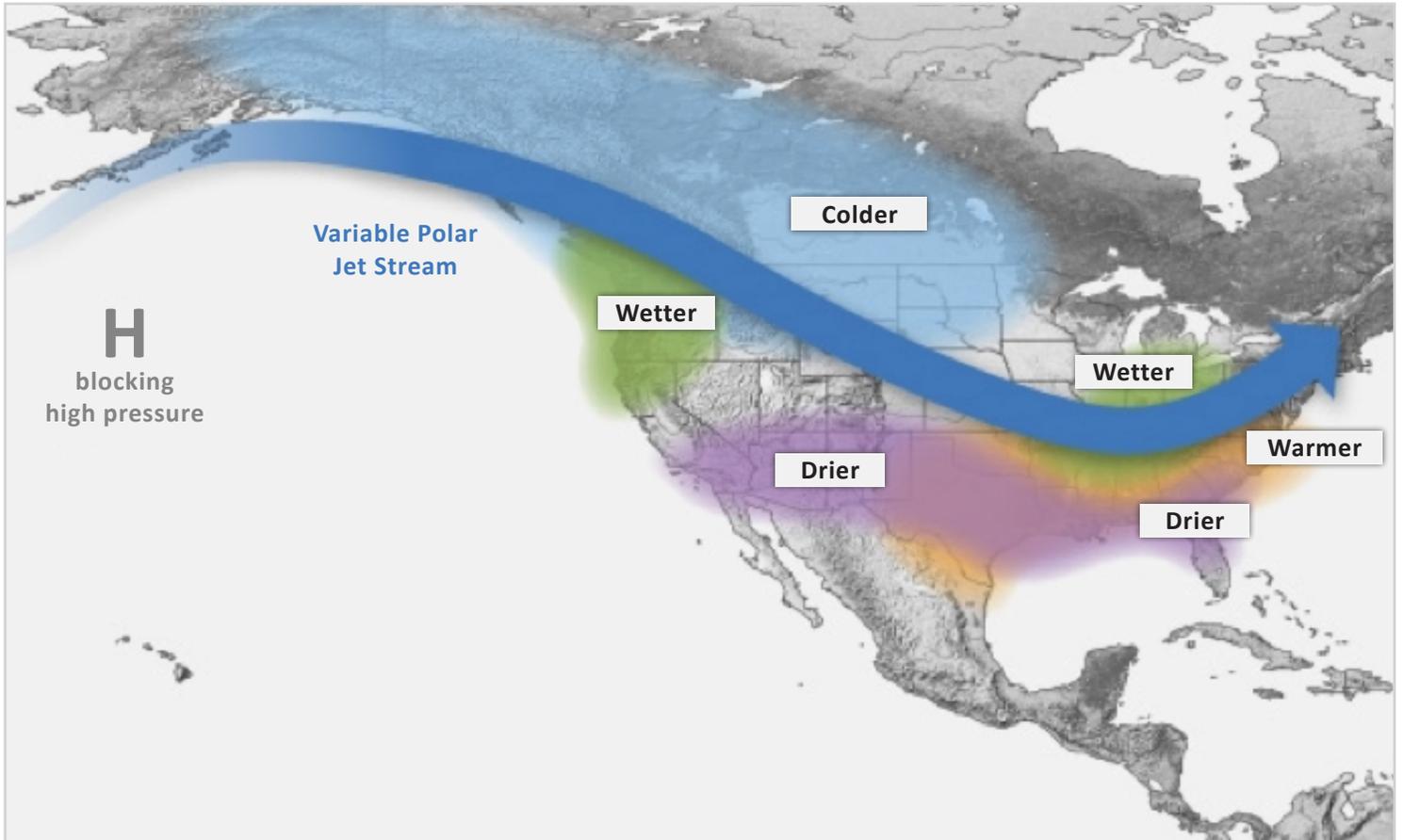


Figure 4

Source: NOAAClimate.gov

Most people know Sir Isaac Newton’s Third Law of Motion: Every action has an equal and opposite reaction. However, the laws of physics don’t have a direct correlation to climate activity. For example, the U.S. Climate Prediction Center (CPC) in March forecast a 50 percent likelihood of a fall 2016 La Niña event, which is the cool sea-surface temperature phase of ENSO. That even-money projection by climatologists is warranted, given the uneven historical connection of El Niño to La Niña events in relatively close order.

Climate experts define El Niño or La Niña events by calculating how far above – or below – sea-surface temperatures move against long-term averages. Since 1950, there have been seven moderate El Niño events, which are defined by climatologists as water temperatures of 0.5 to 1.5 degrees C over the average ONI. Those events were followed by four La Niña cycles of weak to moderate intensity.

In the three strong El Niño cycles over the past 65 years, only one resulted in an equally potent La Niña event the following year (1972-73). While the 1997-98 cycle was very similar to the most recent El Niño in terms of sea-surface heating, the follow-on La Niña event was much more temperate (see Figure 4).

Sea surface temperature anomalies following moderate El Niño events

El Niño year	Average ONI (Aug-Mar)	Average ONI one year later
1957-58	1.41	0.53
1963-64	1.02	-0.65
1965-66	1.49	-0.22
1987-88	1.09	-1.51
1991-92	1.19	0.03
2002-03	1.02	0.31
2009-10	1.10	-1.29
AVERAGE	1.19	-0.40

Sea surface temperature anomalies following strong El Niño events

El Niño year	Average ONI (Aug-Mar)	Average ONI one year later
1972-73	1.66	-1.67
1982-83	1.90	-0.55
1997-98	2.10	-1.30
AVERAGE	1.89	-1.17

Figure 5

Source: Climate Prediction Center, NOAA

In its most recent forecast discussion, CPC researchers concluded that a La Niña event was likely to develop in fall 2016 and last through the middle of 2017. However, using regression analysis all the way back to 1950 to calculate probable intensity, the “best guess” was for Pacific sea-surface temperatures this fall to settle in a range of 0.5 to 1.0 below the average ONI.⁶ If accurate, that would translate into a relatively weak La Niña phenomenon.

In a typical La Niña event, cooler Pacific waters tend to cause the jet stream to bump north toward Alaska and western Canada. Within the AgriBank District, this raises the odds for colder than average winter weather across the Northern Plains and a wetter outlook for much of Arkansas, Missouri, Illinois, Indiana, Tennessee, Kentucky and Ohio.⁷ However, like its warmer-water cousin, a La Niña cycle can produce unexpected effects on U.S. weather. For example, during the winter of 2010-11 (the season following the most recent strong El Niño period), North Dakota, Minnesota and Wisconsin all posted near-seasonal temperatures, while below-normal cold actually dipped into the lower Mississippi Valley and Great Lakes regions. On the other hand, the Northern Plains received above-normal precipitation, while the remainder of the AgriBank District had near- or below-normal rain or snowfall.⁸

An El Niño to La Niña Transition: Potential Effects on Production, Prices

As El Niño gradually gives way to an expected La Niña event later this year, the key question is this: Will weather fluctuations disrupt crop production?

In its most recent long-term projection, CPC projects that temperatures from May through July will remain above normal, with the highest confidence for that forecast in eastern Wisconsin, Michigan, northeastern Indiana and northern Ohio. Meanwhile, precipitation is forecast to be below average for much of the eastern part of the District, with southern Michigan, northern Indiana and all of Ohio having the strongest odds for drier conditions.⁹

Historically, a pattern shift does affect crop production. For example, a recent Reuters analysis noted that U.S. corn yields fell an average of nearly 9 percent during a half-dozen of the most recent growing seasons involving an El Niño-

to-La Niña transition. And, when viewing the three strongest El Niño events since 1960, just one was followed by a strong corn harvest the following year (1998). During these same crop years, soybean yields dropped an average of 6.5 percent.¹⁰ The sharpest overall decline came during the brutally hot summer of 1988, when corn yields fell nearly 30 percent and soybean harvests were down over 20 percent (see Figure 6).

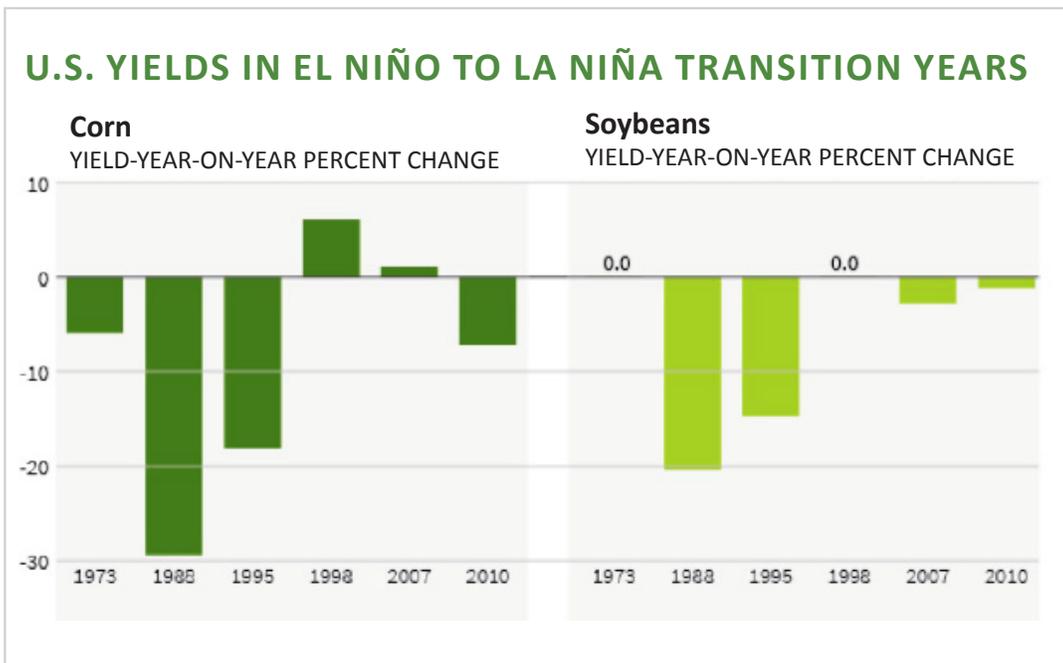


Figure 6

Source: USDA



What can we expect for the 2016 growing season? In a detailed analysis, the University of Illinois Department of Agricultural and Consumer Economics reports that there is a historical correlation between above-average late fall precipitation and lower yields for the following year's corn crop. Given the heavy, El Niño-fueled rainfall that hit much of the corn belt in November and December 2015, researchers Scott Irwin and Darrel Good said it's prudent for producers to consider an "elevated risk" for below-trend corn yields this upcoming season.¹¹ For soybeans, while yield was slightly higher (less than a bushel per acre) in two previous crop years after a significant El Niño event, it was down by over five bushels an acre for a third one similar to the 2015 cycle. For that reason, they believe there is also elevated risk for a below-trend 2016 soybean crop¹²

During these prior El Niño-to-La Niña periods, crop prices tended to spike in reaction to lower yields. In fact, the average rise in transition-year corn prices was just over 39 percent for corn and nearly 32 percent for soybeans. In 2010, corn prices spiked by nearly 52 percent, while soybean prices were up just slightly from the six-cycle average (see Figure 7).

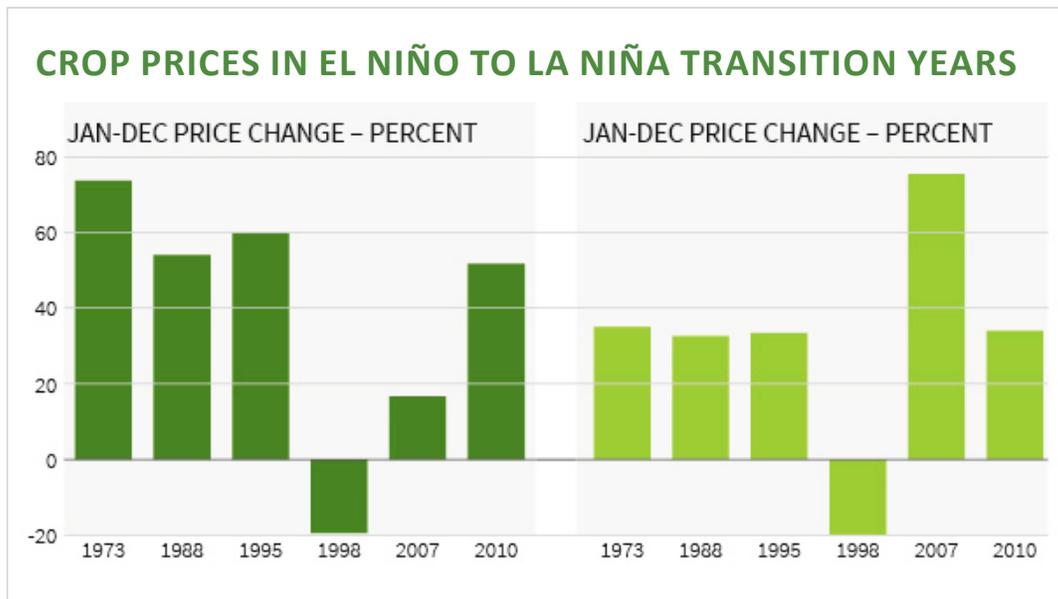


Figure 7

Source: USDA



For 2016, however, the normally favorable transition year most likely won't offset current pricing headwinds, such as recent domestic bumper crops, ample worldwide corn and soybean stocks, and a strong U.S. dollar that hinders exports. During a recent agricultural outlook forum, USDA officials said that while the El Niño weather pattern would likely persist through the spring, it has yet to materially affect price futures on grains and oilseeds. Taken as a whole, this scenario does not support any strong upward price moves for the upcoming season. Let's take a quick look by crop:



CORN. In the agricultural outlook forum, USDA officials estimated that harvested corn acres would rise about 2 percent this season (from 80.7 to 82.3 million acres), with an average yield of 168 bushels per acre. If that projection holds, the season-end inventory of corn stocks would reach a 12-year high, and USDA forecast average corn prices would fall to a cash price of about \$3.45 per bushel.¹³ Similarly, the University of Illinois analysis projects an average corn yield of 166.2 bushels per acre, which researchers said would most likely keep prices near current levels.



SOYBEANS. There are some bright spots in the soybean outlook. Despite the strong U.S. dollar, USDA believes soybean exports will rise due to lower supplies in Argentina and Brazil, and a small forecast decline in year-end U.S. soybean stocks is expected to boost soybean oil prices from 30 to 32 cents per pound. But, with global supplies expected to rise 3 percent, USDA projected that average soybean prices would drop to \$8.50 per bushel.¹⁴ However, the University of Illinois projection calls for a more conservative average yield of 45.5 bushels per acre (compared to the USDA estimate of 46.7). If weather or other factors drive that harvest even lower, it would cut into forecast year-end stocks, which could have positive pricing implications.



WHEAT. Unlike corn and soybeans, winter wheat plantings have been in steady decline, and USDA forecast an additional 7 percent drop in 2016 (from 54.6 million planted acres in 2015 to 51 million acres this year). While exports are expected to rise nearly 10 percent this season, the average yield per acre is also projected to move up, from 43.6 bushels last year to 45.9 bushels in 2016. As a result, USDA says year-end wheat stocks could actually be slightly higher than last year's total of 966 million bushels, which would help drive prices down to about \$4.20 per bushel. If the projections hold, that would be the fourth-consecutive year of price declines for wheat.¹⁵



RICE. The outlook is more positive for rice producers. While USDA expects yields to rise about 2.2 percent (from 7,470 pounds per acre in 2015 to 7,633 this year), year-end stocks are forecast to decline on the strength of higher domestic use and export sales. As a result, prices will most likely hold steady at about \$12.90 per million hundredweight (cwt).¹⁶

Based on the challenging price environment, it's no surprise that overall net farm income is expected to decline for 2016, though the expected drop is modest compared with last year (see Figure 8).

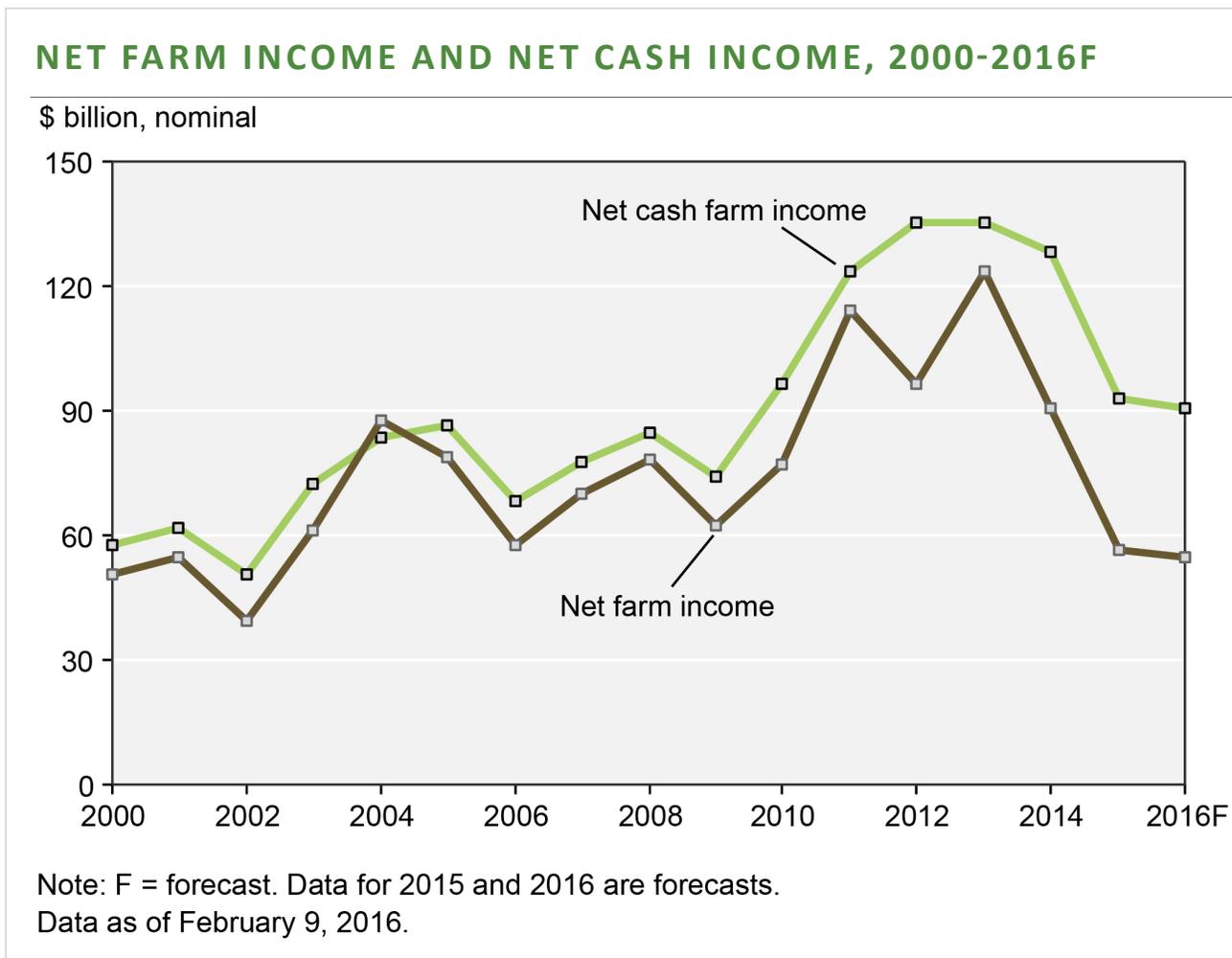


Figure 8

Source: USDA, Economic Research Service, Farm Income and Wealth Statistics

While USDA's February forecast called for overall net cash receipts to drop 2.5 percent, cash income from crop sales is projected to fall just under 1 percent. For corn, cash receipts are expected to fall as much as 36 percent through 2016, as high inventories and weak pricing will offset any potential production gains. The news is slightly better for soybean producers, who may see a 1.5 percent rise in cash receipts for their crop, and much better for rice farmers, who could receive a 31 percent bump in cash receipts for this growing season.

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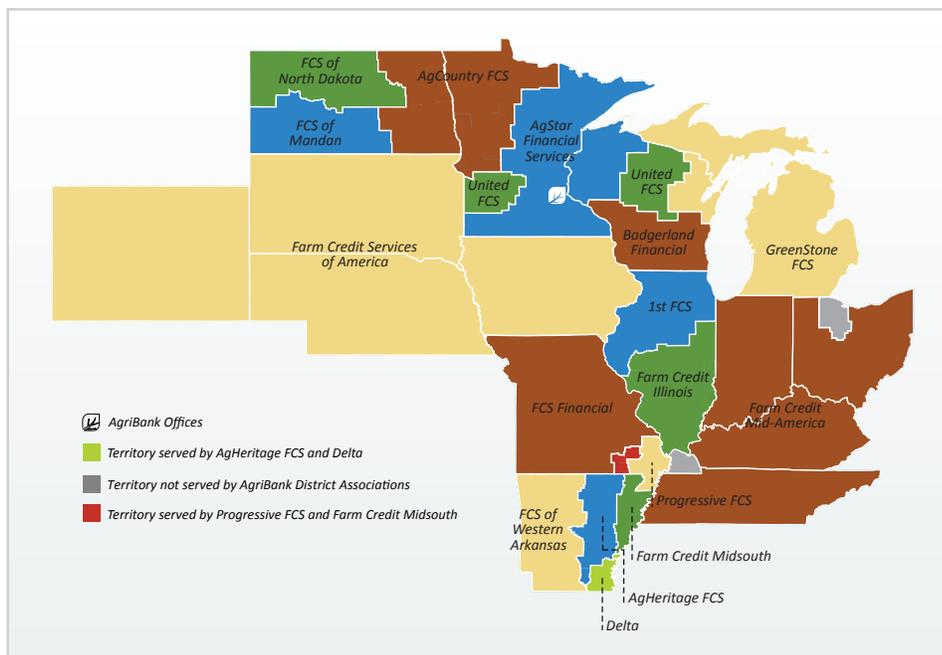
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AgriBank is one of the largest banks within the national Farm Credit System, with nearly \$100 billion in total assets. Under the Farm Credit System’s cooperative structure, AgriBank is primarily owned by 17 affiliated Farm Credit Associations. The AgriBank District covers America’s Midwest, a 15-state area stretching from Wyoming to Ohio and Minnesota to Arkansas. With about half of the nation’s cropland located in the AgriBank District, and nearly 100 years of experience, the Bank and its Association owners have significant expertise in providing financial products and services for rural communities and agriculture. For more information, please visit www.AgriBank.com.

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