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Spanning the Globe — Importance of Yield to Expanding U.S. Corn, Soybean, and Wheat Exports

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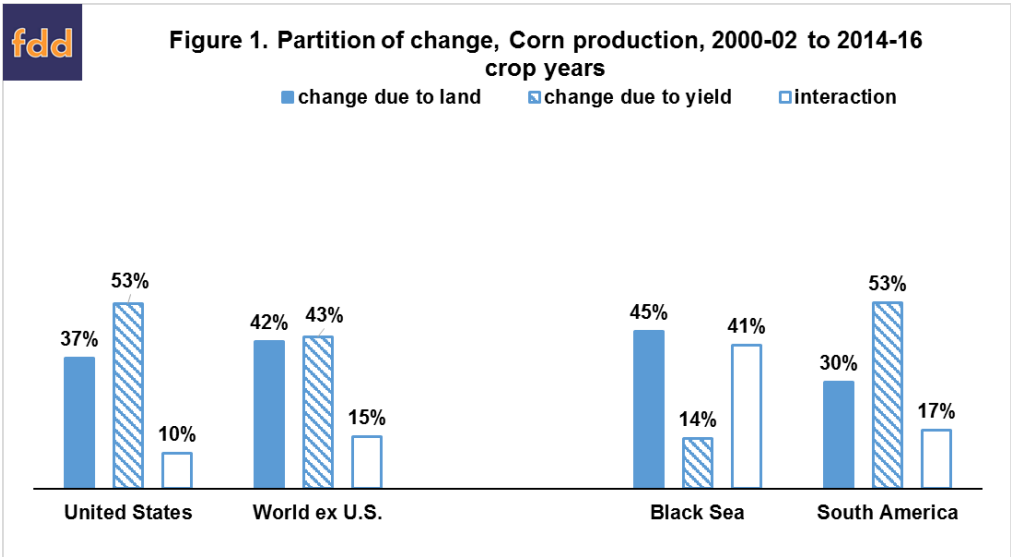
Worldwide demand for agricultural products will likely grow as higher incomes change diets around the world, especially in developing countries. Much of the ensuing increase in production will come from current areas of large production, including the U.S., South America, and Black Sea. To understand the potential growth in production, this article quantifies the role of yield and acreage changes in increasing corn, soybean, and wheat production around the world since 2000. It is motivated by an observation in the June 2, 2017 *farmdoc daily* article that the U.S. is more dependent on yield for increasing production. This observation is confirmed. Moreover, yield of corn and wheat has generally increased slower in the U.S. than other major exporters. A bright spot is that soybean yield increased nearly three times faster in the U.S. than South America. These findings suggest increasing yield growth is important if the U.S. to maintain its position as a major agricultural exporter. Also, production reductions associated with land retirement programs need to be considered carefully given a goal of increasing U.S. agricultural exports.

Data and Methods

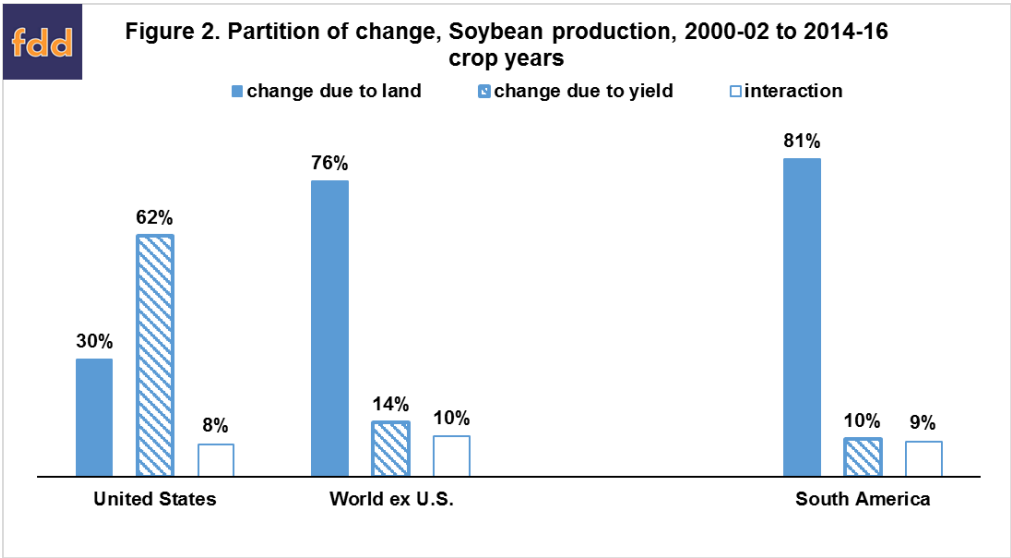
Harvested land, production, and exports, measured in physical units; were collected from the U.S. Department of Agriculture, Foreign Agriculture Service for Australia, Black Sea area (Kazakhstan, Russia, Ukraine), Canada, European Union (EU) (28 countries), South America, U.S., and world. The analysis starts with 2000. Not only is 2000 the turn of the century, but It approximately coincides with the end of the contraction in acreage in the Black Sea area after the breakup of the Soviet Union. Due to the variation in annual production caused by weather and other factors, averages are computed for the 2000-01 through 2002-03 (2000-02) and 2014-15 through 2016-17 (2014-16) crop years. The change in production between these two periods is partitioned into the percent change due to (1) change in

harvested land, (2) change in yield, and (3) interaction of these two changes (see data note 1 for additional discussion of this method).

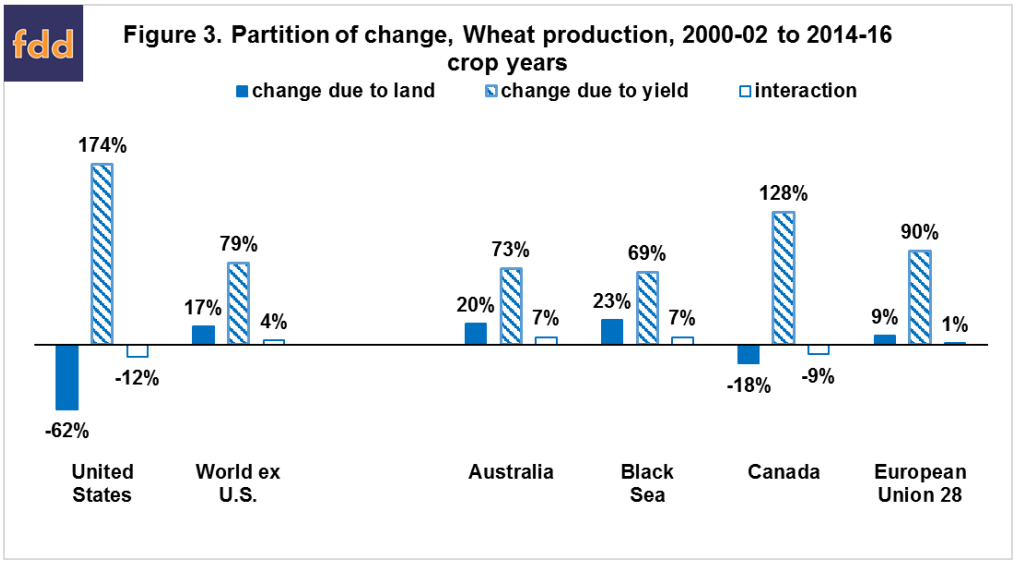
Corn: During the 2014-16 crop years, 90% of world corn exports came from South America, the U.S., and Black Sea area, with individual shares of 38%, 36%, and 16%, respectively. Higher yield accounted for 53% of the increase in U.S. corn production since 2000 (see Figure 1). Yield's share was the same for South America (53%) but much smaller for the Black Sea area (14%).



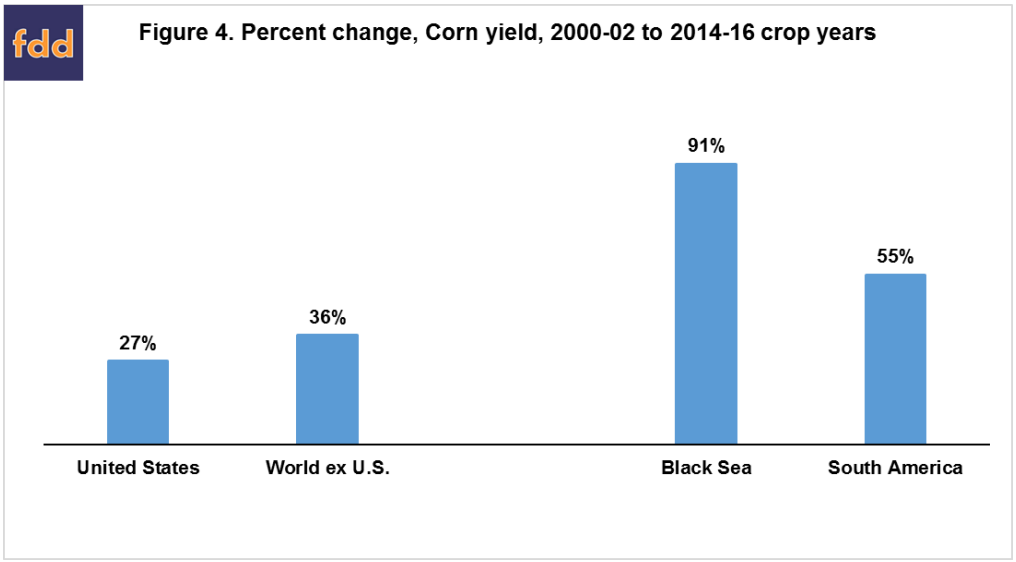
Soybeans: During 2014-16, 94% of world soybean exports came from South America (55%) and the U.S. (39%). Since 2000, yield accounted for 62% of the increase in soybean production in the U.S. but only10% of the increase in South America (see Figure 2). In contrast, acres harvested increased 69.7 million in South America but only 9.7 million in the U.S. The increase in South American acres equals 85% of average acres harvested for soybeans in the U.S. in 2014-16.



Wheat: During 2014-16, 84% of world wheat exports came from the Black Sea area (27%), EU (19%), U.S. (14%), Canada (13%), and Australia (11%). Yield accounted for the entire increase in U.S. production of wheat since 2000 as fewer acres were harvested in 2014-16 than 2000-02. Thus, land had a negative contribution to the change in U.S. wheat production (see Figure 3). The only other major exporter with a decline in harvested wheat area was Canada.



Yield Growth: Since 2000, the percent increase in U.S. corn yield was less than half that of South America and less than one-third that of the Black Sea area (see Figure 4). In contrast, soybean yields increased nearly 3 times faster in the U.S. than in South America (see Figure 5). Wheat yields grew slightly more in U.S. than the EU (19% vs. 17%) but less than in the Black Sea area (30%), Australia (34%), and Canada (54%). Yield increases were more important for expanding wheat production than corn and soybean production across the major exporters of each crop. Since 2000, yield increases accounted for a minimum of 69% of the increase in wheat production for major wheat exporters (see Figure 3), which exceeds the role of increasing yield in expanding U.S. corn and soybean production.



Role of Land: It is widely accepted that the U.S. has less land that can be converted to tilled cropland than many countries, especially countries in South America and the Black Sea area. Moreover, corn, soybeans, and wheat make up a larger share of land currently harvested for grains, oilseeds, and cotton in the U.S. (88%) than in other major exporters except South America (also an 88% share) (see Figure 7). The U.S. (and South America) thus has less potential to shift land to corn, soybeans, and wheat from other grains, other oilseeds, and cotton. These two observations on the potential role of land conversion underscore U.S. dependence on yield to increase production of corn, soybeans, and wheat.

Figure 5. Percent change, Soybean yield, 2000-02 to 2014-16 crop years

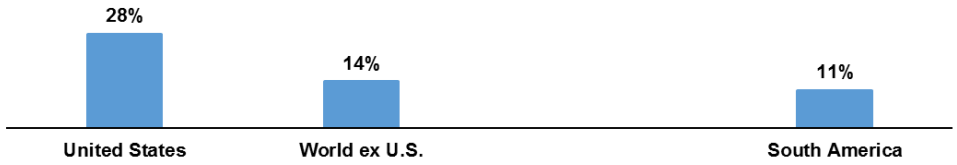


Figure 6. Percent change, Wheat yield, 2000-02 to 2014-16 crop years

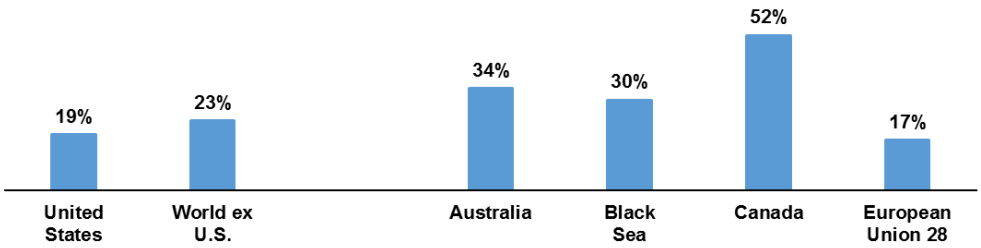
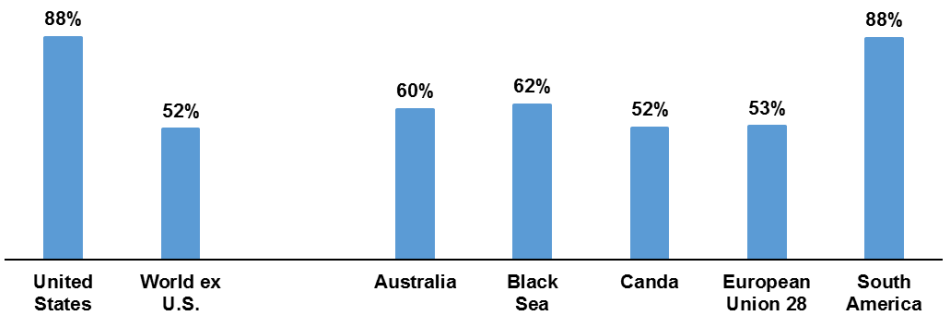


Figure 7. Share of harvested grain, oilseed, and cotton land in corn, soybeans, and wheat, 2014-16 crop years



Summary Observations

- Since 2000, the U.S. has been more dependent on yield to increase corn, soybean, and wheat production than the rest of the world in general and other major exporters in particular. An exception is that yield has played the same role in U.S. and South American corn production.

- Yield of corn and wheat has generally increased less since 2000 in the U.S. than our major export competitors. In contrast, soybean yield has increased nearly three times faster in the U.S. than South America.

- The two preceding findings imply that, if the U.S. is serious about increasing corn, soybean, and wheat exports; then increased funding for yield-enhancing research is likely to be an important component of such a commitment.

- U.S. generated enhancements to yield will be adapted by other countries; tempering, if not eliminating, the initial U.S. advantage. Thus, U.S. yield research must maintain a dynamic cutting edge for exports to expand, which increases the cumulative cost of a yield strategy.

- Interacting with the discussion on increasing exports is the discussion about expanding land retirement programs, such as the Conservation Reserve Program (CRP) (*farmdoc daily*, May 4, 2017). In addition, at a recent hearing by the Senate Agriculture Committee, the removal of highly productive land by CRP surfaced as an issue (*Farm Policy News*, July 3, 2017).

- In assessing the impact of expanding land retirement programs on exports, an important question needs to be assessed: “What is the rest of the world’s response to a 1 acre increase in land put into a U.S. land retirement program?” Alternatively stated, “Does the rest of the world increase acres by more, less, or equal to a one acre increase in land in U.S. land retirement programs?”

- In short, caution is in order when assessing the U.S.’s ability and willingness to increase corn, soybean, and wheat exports, especially U.S. share of world exports. This multifaceted debate touches not only on export policy but also research and conservation policy. It remains to be seen if expanding U.S. farm exports will in fact become a U.S. farm policy driver.

Data Note

1. Change in production is partitioned into percent share due to the change in harvested land, change in yield, and interaction of these two factors. Given L = land, Y = yield, 1 = early period, and 2= later period; $(L_2Y_2 – L_1Y_1) = [(L_2 – L_1)(Y_1)] + [(Y_2 – Y_1)(L_1)] + [(L_2 – L_1)(Y_2 – Y_1)]\}$. This equation is read as change in production between periods 1 and 2 (left hand term) equals change in production due to change in harvested land (first right hand term) plus change in production due to change in yield (second right hand term) plus change in production due to the interaction of the changes in harvested land and yield (third right hand term). Percent share of the change in production is calculated as $[(L_2 – L_1)(Y_1)] / (L_2Y_2 – L_1Y_1)$ for land, $[(Y_2 – Y_1)(L_1)] / (L_2Y_2 – L_1Y_1)$ for yield, and $[(L_2 – L_1)(Y_2 – Y_1)] / (L_2Y_2 – L_1Y_1)$ for the land-yield interaction.

References and Data Sources

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2. Good, K. “Senate Farm Bill Conservation Hearings – Conservation Reserve Program.” *Farm Policy News.* Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign. July 3, 2017.

3. U.S. Department of Agriculture, Foreign Agricultural Service. “Production, Supply, and Distribution Online.” June 2017. https://apps.fas.usda.gov/psdonline/

4. Zulauf, C., A. Lines, and N. Pryshliak. "Spanning the Globe - Corn, Soybean, and Wheat Production and Exports since 2000: Focus on the Black Sea Area and the U.S." *farmdoc daily* (7):102, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, June 2, 2017.