Thoughts on Implications of Brazilian Soybean Production on Selected States

By George Flaskerud

Abstract

Soybean production in Brazil has grown rapidly in recent years. This article examines the potential impact of Brazilian soybean production on North Dakota and other U.S. producers. Brazil, followed by Argentina, is the leading soybean producer in South America. All South American soybean production surpassed the United States during 2002-03. In Brazil, production and yields have grown the fastest in Mato Grosso (Center-West) and other expansion states that have savannah-like flatland (Cerrado land). Soybean costs of production for 2003 harvest are considerably lower in Mato Grosso than in North Dakota and Iowa even when freight costs to Rotterdam are considered, giving Brazil a strong competitive position in the world market. A tripling of soybean production in Brazil is possible. But, it appears that world demand can accommodate the current pace of growth in Brazil at prices profitable to at least North Dakota producers.

Introduction

Soybean production in Brazil has grown rapidly in recent years, production grew from 18 million metric ton (mmt) in 1987-88 to 51 mmt in 2002-03 according to statistics from USDA. The impact on U.S. producers has been pronounced. While world trade in soybeans grew by 33.1 mmt during the 1987-2002 marketing years, Brazil exports grew by 17.8 mmt and U.S. exports grew by only 5.2 mmt. During that same period, the amount of soybeans crushed also increased more in Brazil than in the United States.

Meanwhile, North Dakota soybean production accelerated (NASS). Planted acres increased from 520,000 in 1987 to 3 million in 2003 while U.S. planted acres increased from 58.2 million in 1987 to 73.7 million in 2003.

The situation and outlook for soybeans in Brazil has become important to North Dakota and other U.S. producers. How much soybean growth in Brazil is likely in the future? How competitive are North Dakota and other U.S. producers with Brazil? How much production can the world market absorb at prices profitable to North Dakota and other U.S. producers?

The objective of this article is to evaluate the potential impact of Brazilian soybean production on North Dakota and other U.S. producers. Specific objectives include:

- Examine the development and potential for soybean production in Brazil
- Compare Brazil and U.S. costs of production for soybeans
- Appraise world demand for soybeans

George Flaskerud is extension crops economist and professor in the Department of Agribusiness and Applied Economics at North Dakota State University. He received his B.S. and M.S. degrees from North Dakota State University and a Ph.D. degree from Oklahoma State University. His research interests include price analysis and risk management.

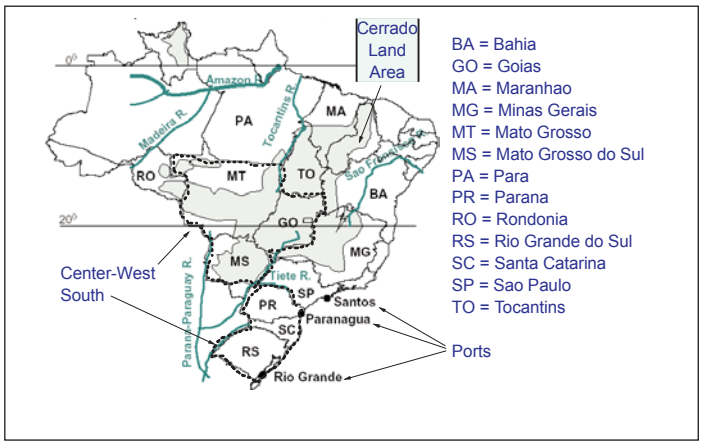
The evaluation is based on data from various publications. The infrastructure of Brazil is presented first. This is succeeded by a description of production in Brazil and an analysis of production costs. Soybean use is examined, followed by an evaluation of potential soybean expansion in Brazil. In the final section, implications are derived for North Dakota and other U.S. producers.

Infrastructure

Geography

Brazil's crop production that competes with U.S. production is concentrated in two main regions, the South and the Center-West (Schnepf, Dohlman and Bolling, pp. 7-8). Regions, states and ports are identified in Figure 1.

Figure 1. Brazil Select Features



Southern Brazil has been the historical center of Brazil's soybean production. It includes the states of Parana, Santa Catarina, and Rio Grande do Sul. It has three major ports: Santos, Paranagua, and Rio Grande.

Center-West includes the states of Mato Grosso, Mato Grosso do Sul, Goias, and the Federal District surrounding Brazilia. Development of this area began in the 1960s and its production is comparable today with Southern Brazil.

Brazil is about the size of the continental United States in land area. Southern Brazil is a little over three times the size of North Dakota while the Center-West is about nine times bigger. The terrain in Southern Brazil is rolling while the Center-West is relatively flat.

Brazil's growing conditions are very favorable for soybean production which is about six months later than in the United States. Soils in the South region are naturally productive (Huerta and Martin). In contrast, the fertility of the Center-West soils must be enhanced with nitrogen, phosphorus and lime.

Development

The government effectively promoted economic development in agriculture with a number of policies (Schnepf, Dohlman and Bolling, pp. 35-42). The 1960s policy of making free tracts of government land available in the Center-West marked the beginning of its development. Public funding of agricultural research and experiment stations also began in the 1960s with the establishment of EMBRAPA (Brazilian Agency for Research on Agriculture and Animal Husbandry). It developed a tropical soybean which was critical to expansion of production in the Center-West.

A number of economic reforms were introduced by the government beginning in the early 1990s to minimize government interference in the marketplace. One of the most significant reforms was the effective removal, in 1996, of export taxes on soybeans, soymeal, and soyoil. The reforms generally stabilized the economy and created a favorable climate for agricultural investment, production, and exports.

Currency

The unit of currency is the Real. It was linked to the U.S. dollar when it was introduced on July 1, 1994 (Schnepf, Dohlman and Bolling, pp. 43-47). The strengthening of the U.S. dollar in the late 1990s resulted in overvaluation of the Real exchange rate. In January 1999, the Real was unlinked from the U.S. dollar and allowed to float. It immediately fell in value.

Devaluation raised prices in Brazil and stimulated additional soybean planting despite declining world prices. On the other hand, the devaluation also increased the cost of dollar-denominated imported inputs such as fertilizer and herbicides.

Suppliers price most inputs in terms of "bags of soybeans" as a way of dealing with inflation, exchange rate changes, and soybean price changes. For example, during January-October 2002 on average, it took 16.4 bags to purchase one metric ton of fertilizer.

Transportation and Ports

Transportation and ports are critical to the growth of Brazilian agriculture. Some commodities in some states must move in excess of 1,500 miles by truck to gain access to an export point (Verdonk). Also, the Cerrado land in Mato Grosso and other states needs essential inputs to be productive.

Production has traditionally been hauled by truck to one of the three ports in the South. In recent years, increasing amounts have been trucked and barged to Itacoatiara, a floating port on the Amazon, which is about 1,200 miles from Cuiaba, Mato Grosso, and about 600 miles from the Atlantic (Thompson; Wilson, Koo, Dahl and Taylor). A port was also opened during April 2003 at Santarem which is about 150 miles closer to the Atlantic (Ray).

A number of projects are also under way to improve roads and railroads (Verdonk). Information on the transportation projects can be found on the Brazil Ministry of Transportation Web site.

Farms

Farms in the Center-West Region are generally much larger than in the South. In the Cerrado land area which includes the Center-West, two-thirds of the farms are larger than 2,500 acres compared to an average size of 75 acres in Parana (Schnepf, Dohlman and Bolling, pp. 13 and 57). The South includes a large number of very small farms.

Several farms were visited by the author during February 2003 in the rapidly-growing soybean producing states of Mato Grosso and Mato Grosso do Sul. The farms were well-managed and applied the latest technology. Most were very large with many employees who received $200-$500 per month plus benefits. Housing and a cafeteria were generally provided.

Farm equipment on the farms visited was relatively small, considering the size of farms. This is probably because of low labor costs and also because of extended planting and harvesting seasons. Equipment was maintained on the farm.

Land was valued at $400-$900 per acre depending on development. The value of undeveloped land was very low. Detailed descriptions of farms can be found in articles by Cummins; Dappert; Lamp; White.

Soybean Production

Brazil, followed by Argentina, is the leading producer of soybeans in South America. Total South American production (Figure 2) and harvested acres (Figure 3) surpassed the United States during 2002-03. Yields have been similar in recent years (Figure 4).

Figure 2. Soybean Production in South America vs. U.S.

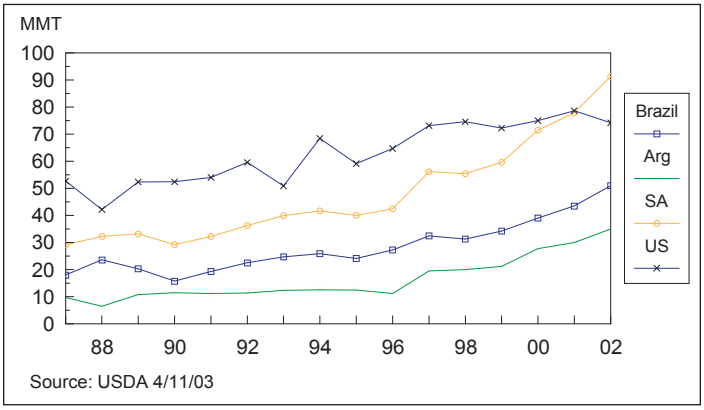


Figure 3. Soybean Harvested Acres in South America vs. U.S.

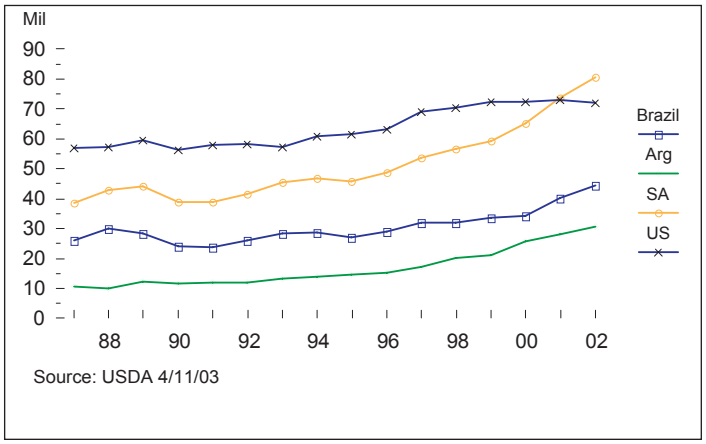


Figure 4. Soybean Yield Per Acre in Brazil vs. U.S.

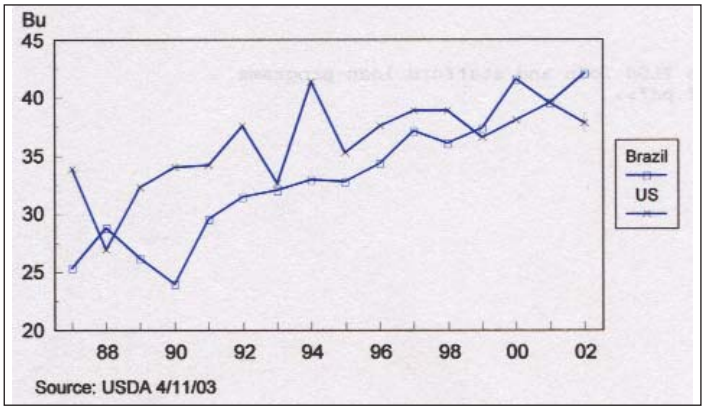


Figure 5. Soybean Production Within Brazil

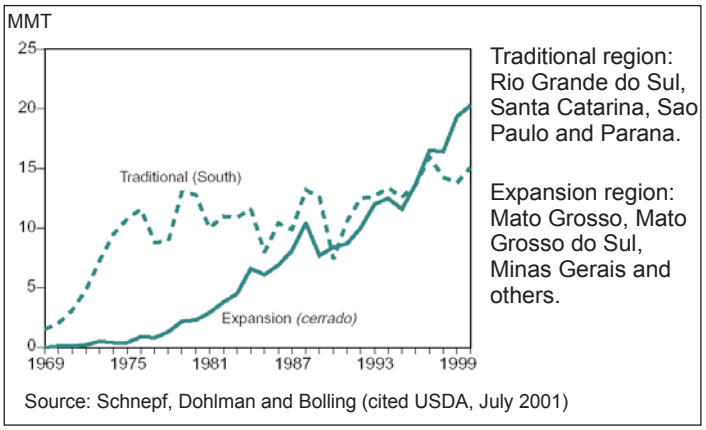
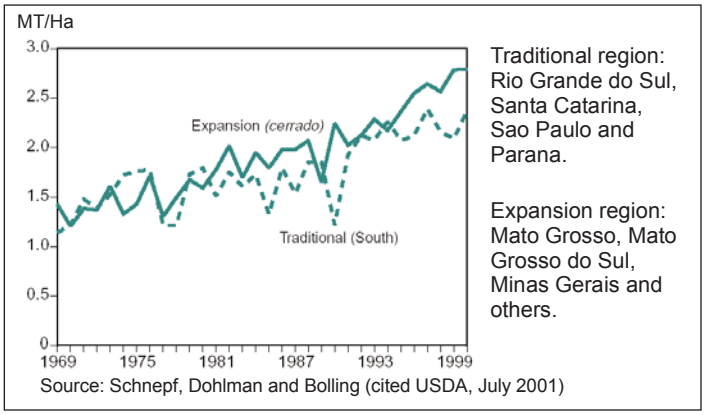


Figure 6. Soybean Yields Within Brazil



Production (Figure 5) and yields (Figure 6) grew the fastest in Mato Grosso and other expansion states that have Cerrado land (Schnepf, Dohlman and Bolling, pp. 40-42). In the traditional area of the South, production and yields have stagnated since the mid-1970s. According to Verdonk, soybean area in 2002-03 was about equally divided between the South and the Center-West although production was greater in the Center-West.

Roundup Ready soybeans and other biotech seeds have been illegal in Brazil. Nevertheless, Verdonk estimated that 10-20 percent of Brazil's 2003 crop is biotech and that 70 percent of the soybean acres in Rio Grande do Sul are Roundup Ready soybeans.

Leaf rust has been found but is considered a limited threat since treatments are available (Verdonk). Left untreated, leaf rust results in premature leaf yellowing and shedding which reduces yield.

Management Practices

Soybeans are planted during October-December for harvest during February-May (Schnepf, Dohlman and Bolling, pp. 9-10). The date ranges are wide since they reflect all of Brazil. The primary growing season in Brazil is September-March.

No-till is the common management practice in Brazil. It is done to reduce the loss of organic matter that can be substantial due to heat and high rainfall.

Most credit to larger farms for soybeans is provided by input suppliers and the companies who buy the crop, since government credit is limited to relatively small producers (Verdonk).

Farmers can store only about five percent of the soybean crop on-farm (Verdonk). However, bigger farms are investing in storage facilities on-farm. Cooperatives, crushers and exporters handle most of the storage. Few soybeans are carried over from one year to the next. The grain trade and farmers rely on the CBOT for their price information (Leibold, Baumel, Wisner and McVey).

Costs of Production

Soybean costs of production for 2003 harvest were considerably lower in Mato Grosso than in North Dakota and Iowa even when freight costs to Rotterdam are considered (Tables 1-4), giving Brazil a strong competitive position in the world market. Consequently, Mato Grosso soybean production is considerably more profitable.

Table 1. Soybean Direct Costs of Production for 2003 Harvest, US$/Ac

	North Dakota	Iowa	Mato Grosso
Seed	29.16	31.25	8.45
Herbicides	9.75	18.68	25.33
Fungicides			5.29
Insecticides			6.54
Fertilizer	1.25	23.15	49.13
Crop Insurance	3.20	3.15	
Machinery Operation	27.98	34.16	24.41
Miscellaneous		7.00	3.23
Operating Interest	1.98	3.91	5.36
Total	73.32	121.30	127.75

Sources: Swenson and Haugen; Duffy and Smith; Richetti and Augusto.

Table 2. Soybean Indirect Costs of Production for 2003 Harvest, US$/Ac

	North Dakota	Iowa	Mato Grosso
Machinery	24.59	26.27	7.91
Land	44.89	135.00	20.24
Miscellaneous	4.11		
Total	73.59	161.27	28.16

Sources: Swenson and Haugen; Duffy and Smith; Richetti and Augusto.

Table 3. Soybean Total Costs of Production for 2003 Harvest, US$

	North Dakota	Iowa	Mato Grosso
Direct Costs/Ac	73.32	121.30	127.75
Indirect Costs/Ac	73.59	161.27	28.16
Total Costs/Ac	146.91	282.57	155.91
Total Costs/Bu	4.59	6.28	3.24
Freight/Bu to Rotterdam	1.17	0.93	1.33
TC/Bu @ Rotterdam	5.76	7.21	4.57

Sources: Swenson and Haugen; Duffy and Smith; Richetti and Augusto; Oil World.

Table 4. Soybean Return to Management for 2003 Harvest, US$

	North Dakota	Iowa	Mato Grosso
Income/Ac	162.88	237.60	207.88
Yield/Ac	32	45	48
Price/Bu	5.09	5.28	4.32
Total Costs/Ac	146.91	282.57	155.91
Return to Mngt/Ac	15.97	-44.97	51.97

Sources: Swenson and Haugen; Duffy and Smith; Richetti and Augusto.

Economic costs are presented since they reflect full opportunity costs for land and machinery investment. Costs and returns should be regarded with caution since methods used to calculate costs may vary by source. In addition, exchange rate changes can have a significant impact. Costs and prices are in U.S. dollars.

Cost of production estimates for North Dakota (Swenson and Haugen), Iowa (Duffy and Smith), and Mato Grosso (Richetti and Augusto) are presented for soybeans harvested in 2003. The Mato Grosso budget was translated by Roger Johnson (Professor Emeritus, personal communications, May 2003).

Some direct costs were combined to accommodate the Mato Grosso budget format. Machinery operations include fuel, lubrication, repairs, custom operations, machinery rent, transportation of harvest to a nearby facility, and labor ($8.10 in North Dakota and $20.25 in Iowa). Labor does not include management. Fixed costs reflect machinery depreciation and interest on investment and land rent as specified in the state budgets.

Freight costs to Rotterdam reflect differences between local prices and Rotterdam prices (Oil World) during 2002, on average. The Rotterdam price is for delivery there and is net of all costs, insurance, and freight (c.i.f.).

The soybean price for Mato Grosso was the Rondonopolis, Mato Grosso, average March 2003 price (ABIOVE). Prices for North Dakota and Iowa are estimates for the 2003 harvest based on the April 7, 2003, November futures price ($5.55) adjusted for the 2002 harvest basis of -$.46 in North Dakota and -$.27 in Iowa. The harvest bases were derived from October 2002 cash prices (NASS) and November 2002 soybean futures prices during October 2002.

The harvest prices used reflect historical relationships. Relative to 1998-02 averages, the price used was 116 percent of average for Rondonopolis, 115 percent for North Dakota, and 114 percent for Iowa.

Direct costs per acre (Table 1) for North Dakota were 43 percent lower than for Mato Grosso. The costs of chemicals and fertilizer were much lower for North Dakota. Direct costs in Iowa were only five percent lower than for Mato Grosso.

Indirect costs per acre (Table 2) for North Dakota were 260 percent of those for Mato Grosso due to higher machinery and land costs (rent). Land rent was particularly high in Iowa.

Total costs per acre (Table 3) were the lowest in North Dakota, somewhat higher in Mato Grosso and the highest in Iowa. Per bushel, total costs were the lowest in Mato Grosso ($3.24) followed by North Dakota ($4.59) and Iowa ($6.28). Total costs per bushel remained the lowest in Mato Grosso even when freight costs to Rotterdam were considered.

Soybean production in 2003 was projected to be over three times more profitable per acre for Mato Grosso than for North Dakota (Table 4). For Iowa, soybeans show a potential substantial loss for this budget that reflects all economic costs of production.

Alternatively, an analysis could be conducted excluding land rent, in effect, the return to land. Since the return to land is determined by profitability, it could be argued that the real competitive position of different production areas would be measured by removing the land rent charge.

Under this scenario, the three areas analyzed are competitive; cost differences would be insignificant. Total costs per bushel would be $2.82 in Mato Grosso, $3.19 in North Dakota, and $3.28 in Iowa. After considering freight costs to Rotterdam, total costs per bushel would be $4.15 in Mato Grosso, $4.36 in North Dakota, and $4.21 in Iowa.

Soybean Use

The amount of soybeans crushed in Brazil continues to increase (Figure 7). The amount crushed in South America surpassed U.S. crush in 2002-03. Sixty percent of Brazil's crush capacity is located in the southern states of Parana, Rio Grande do Sul, Sao Paulo, and Santa Catarina although crushing capacity is gradually shifting to the Center-West Region, according to Verdonk.

Soybean exports are growing at a rapid pace in Brazil (Figure 8). South American exports surpassed U.S. exports during 2002-03. During the same year, South America captured a larger percentage of the world soybean market than did the United States (Figure 9). Brazil's share of the world soybean export market has increased sharply since 1987 while market share has declined in the United States.

Figure 7. Soybean Crush in South America vs. U.S.

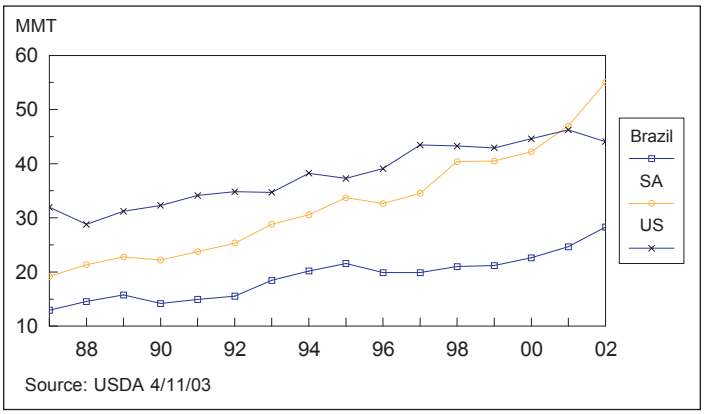


Figure 8. Soybean Exports in South America vs. U.S.

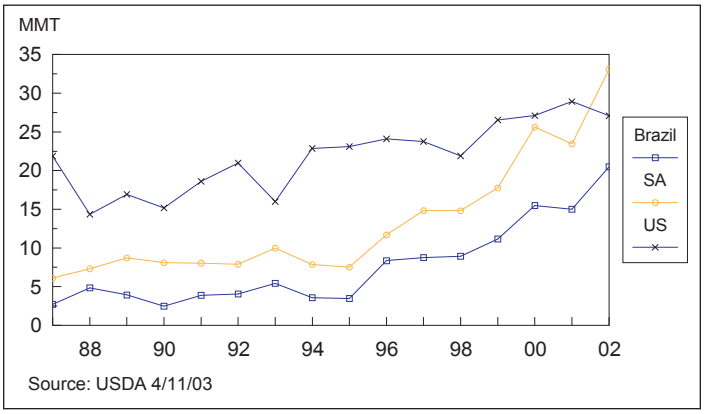
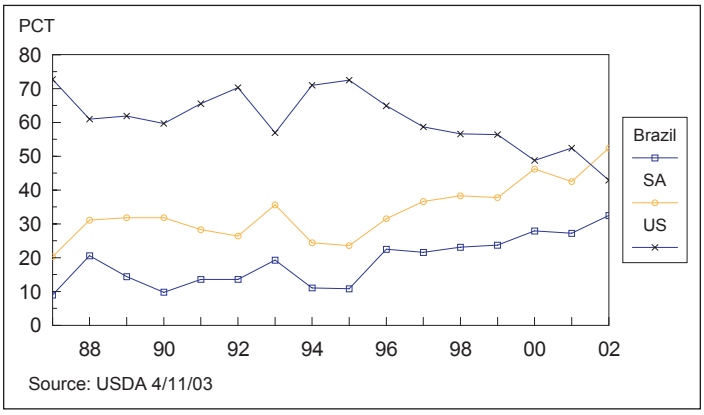


Figure 9. Soybean Market Share



Expansion

A 500 percent increase in Brazil cropland acres is possible, according to Shean. The current cropland base of 103 million acres could be expanded to 519 million acres. Cropland in the United States totals 430 million acres.

The additional land could be developed by clearing new land and by converting pastureland (Table 5) (Shean). An estimated 161 million acres could be developed by clearing new land and 173-222 million acres could be developed by converting pastureland.

Table 5. Additional Land Available for Soybean Production in Brazil

	Million Acres
Virgin Cerrado	161
Pasture Conversion	173 - 222
Amazonia	25
Total Additional Land	358 - 420
Additional Soybeans	124 - 247

Source: Shean (cited EMBRAPA and USDA)

An estimated 124-247 million acres of additional soybeans could be grown on the additional cropland. An estimated 44.5 million acres were harvested in 2002-03. In effect, soybean acres in Brazil could more than triple.

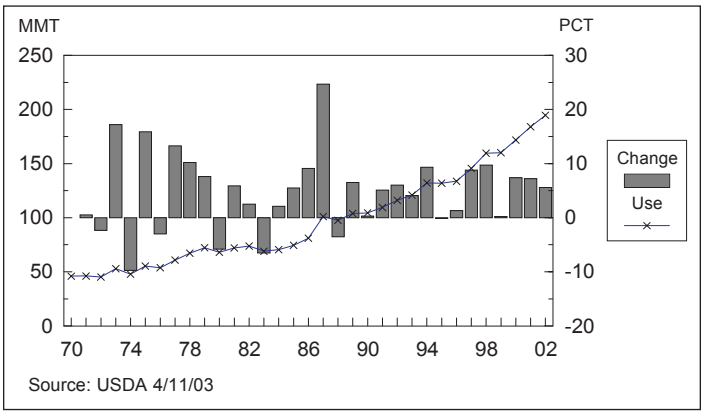
Most of the 4.1 million increase in 2002-03 harvested acres came from new land and pastureland (Verdonk). According to Verdonk, this kind of growth is possible for a number of years.

Implications

It would appear that world demand can accommodate the current pace of growth in Brazil and the rest of South America at prices profitable to at least North Dakota producers. World demand of soybeans has grown at an annual rate of 4.8 percent, on average, since 1970 (Figure 10). During the last 10 years (1993-02), demand has grown annually at 5.4 percent, on average. World production grew at an annual rate of 4.1 percent during the 1997-02 marketing years. Most of that growth came from South America, especially Brazil.

The data does not suggest that soybean production will shift from the United States to South America but rather that significant growth will continue in South America while U.S. production will reflect yield increases and some acreage increases. As low cost producers, Brazil will be able to expand production even in a situation of relatively low soybean prices although infrastructure development will constrain the rate of soybean expansion. U.S. farm managers will continue to shift acres among crops depending on incentives.

Figure 10. World Soybean Use



Competing production alternatives are likely to temper expansion of U.S. soybean acres. The 1997-03 soybean acre range of 70-74.3 million acres (73.2 million in 2003) is likely to increase only modestly over time.

North Dakota and other states outside the major soybean producing region will likely see soybean-planted acres increase, although at a slower pace than in the past, while planted acres in major soybean states may vacillate in a sideways pattern. Planted acres increased by 1.85 million acres between 1997 and 2003 in North Dakota whereas they fluctuated within a range of 10.5-11 million acres in Iowa.

Soybean prices will be sensitive to growing conditions in both the United States and South America especially during marketing years with relatively low carryover stocks at both the U.S. and world levels such as in 2003-04. The price impact of adverse conditions in the United States when stocks are low, however, will likely be less than in the past due to the offsetting effect of two major soybean crops produced approximately six months apart. But, if both countries experience consecutive production problems, the impact could be substantial when stocks are low.

South American soybean production and exports clearly began to impact the relationship between the U.S. stocks/use ratio and price beginning in 1999-00 (Figure 11). The average 2002 October price of the Chicago Board of Trade (CBOT) November soybean futures contract was $5.47 when USDA's

October stocks/use estimate was 6.5 percent. Stocks this tight in the past have warranted at least $6 in the futures.

Several more years of data are needed to develop a more thorough and accurate relationship between stock/use and price. For now, the graph in Figure 11 can only serve as an approximation to prices. It appears that the projected price may need to be discounted by $1-$1.50, depending on development of the South American crop.

Figure 11. Soybean Stock/Use and Price

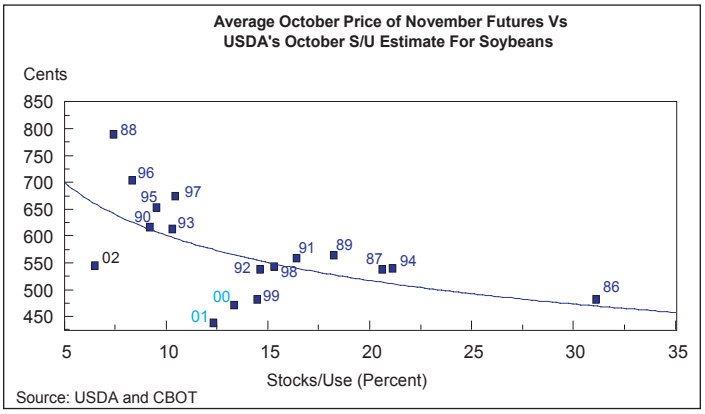
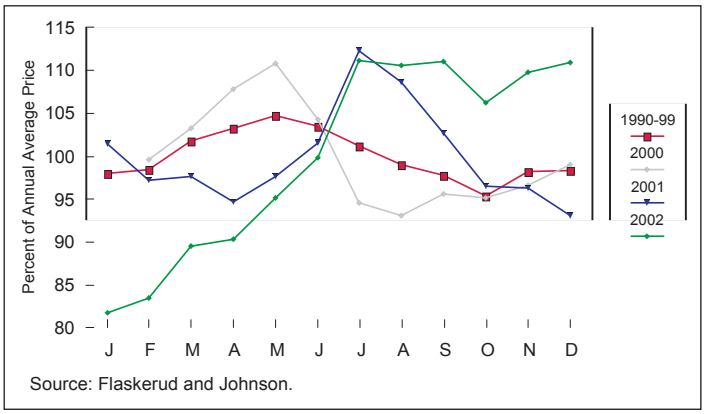


Figure 12. Soybean Seasonal Pattern for the Minneapolis To-Arrive Cash Price



The U.S. seasonal price pattern for soybeans may also be influenced by the increased export competition from Brazil and the rest of South America (Figure 12). But, recent price patterns do not provide evidence of a change. Prices peaked during May 2000 and during July 2001 and 2002. Under favorable growing conditions in South America and the United States, however, a price peak by mid-March would be expected, about the time that South American exports begin to intensify.

During a U.S. short-crop year, farm managers may be well advised to target prices somewhat lower than previous highs. In addition, farm managers should consider forward contracting next year's production earlier than normal, although a smaller-than-expected crop in South America could lead to a price peak near May, the traditional seasonal high (Flaskerud and Johnson). High soybean prices, relative to alternative crop prices, would likely lead to increased soybean acres in the United States as well as in South America which could drop prices to loan levels.

Summary and Conclusions

Soybean production in Brazil has grown rapidly in recent years, and soybean exports have grown accordingly. The objective of this article was to evaluate the potential impact of Brazilian soybean production on North Dakota and other U.S. producers.

Brazil's soybean production is concentrated in two main regions. The South has been the historical center of Brazil's soybean production but the Center-West is comparable today with the South. Soils in the South are naturally productive while the fertility of the Center-West soils must be enhanced. Production and exports accelerated after the export taxes on soybeans, soymeal, and soyoil were removed in 1996.

Improvements to transportation and ports are critical to the growth of Brazilian agriculture. Production has traditionally been hauled by truck to one of three ports in the South. In recent years, increasing amounts have been trucked and barged to a floating port on the Amazon. A number of projects are under way to improve the transportation system.

Brazil, followed by Argentina, is the leading producer of soybeans in South America. All South America soybean production surpassed the United States during 2002 and 2003. In Brazil, production and yields have grown the fastest in Mato Grosso and other expansion states that have Cerrado land.

Soybean costs of production for 2003 harvest are considerably lower in Mato Grosso than in North Dakota and Iowa even when freight costs to Rotterdam are considered, giving them a strong competitive position in the world market. Consequently, Mato Grosso soybean production is considerably more

profitable and can be expanded even when prices are relatively low.

Soybean crush and exports are growing at a rapid pace in Brazil. For both, South America surpassed the U.S. during 2002 and 2003. During the same year, South America captured a larger percentage of the world soybean market than did the United States.

In the future, a 500 percent increase in Brazil cropland acres is possible. The additional land could be developed by clearing new land and by converting pastureland. Soybean acres in Brazil could more than triple. Even so, it would appear that world demand can accommodate the current pace of growth in Brazil at prices profitable to at least North Dakota producers although an expanding world demand is of the utmost importance.

South American soybean production and exports clearly began to impact the relationship between the U.S. stocks/use ratio and price beginning in 1999-00. The U.S. seasonal price pattern for soybeans may also be impacted, but recent price patterns do not provide evidence of a change. Under favorable growing conditions in South America and the United States, however, a price peak by mid-March would be expected.

References

Brazil Ministry of Transportation. www.transportes.gov.br.

Brazilian Oilseed Crushers Association (ABIOVE). www.abiove.com.br.

Cummins, Allen. "Miles and Miles of Soybeans: A Tour of South America." *Soybean Digest*, April 2001. http://soybeandigest.com/ar/soybean_miles_miles_soybeans/index.htm.

Dappert, John. "Farming the Brazilian Frontier." *Successful Farming*, March 5, 2003. http://www.agriculture.com/default.sph/agNotebook.class?FNC=ArticleList_Aarticle_html_8357_12.

Duffy, Mike and Darnell Smith. *Estimated Costs of Crop Production in Iowa – 2003*. Ames: Iowa State University, January 2003.

Federal Reserve Bank of St. Louis. Foreign Exchange Rate Data: Brazil. http://research.stlouisfed.org/red/data/exchange.html.

Flaskerud, George and Demcey Johnson. *Seasonal Price Patterns for Crops*. Extension Bulletin EB-61, Fargo: North Dakota State University, Extension Service, December 2000.

Huerta, Alexandria I. and Marshall A. Martin. "Soybean Production: Competitive Positions of the United States, Brazil, and Argentina." *Purdue Agricultural Economics Report*, November 2002, pp. 4-10.

Hughes, Harlan. "Brazil, 33 Years Later." Beef, April 1, 2003. http://beefmag.com/ar/beef_brazil_years_later/index.htm

Johnson, Roger G. and Mark A. Krause. *Market Potential for Northern Plains Farm Equipment in Brazil*. Agricultural Economics Report No. 338, Fargo: North Dakota State University, Department of Agricultural Economics, December 1995.

Lamp, Greg. "Is the Gold Rush Over: Rising Land Costs and an Abysmal Infrastructure Could Hinder New Farmers from Making Money on Beans in Brazil." *Corn and Soybean Digest*, April 2003, pp. 26-29.

Leibold, Kelvin, Phil Baumel, Robert Wisner and Marty McVey. "Brazil's Soybean Production." *AgDM Newsletter* article, September 2001. http://www.extension.iastate.edu/agdm/articles/leibold/LeibSept01.htm

National Agricultural Statistics Service (NASS). "Database." Available at: http://www.nass.usda.gov:81/ipedb/

Oil World. No. 8, Vol. 46, February 21, 2003.

Ray, Daryll E. "Cargill Opens Soybean Terminal at Santarem on the Amazon in Brazil." University of Tennessee Agricultural Policy Analysis Center weekly article, Knoxville, TN, April 18, 2003.

Richetti, Alceu and Geraldo Augusto. *Table 4. Cost of Producing No-Till Soybeans During 2002-03 for Sorriso, Mato Grosso*. Embrapa, Dourados, Mato Grosso do Sul, August 2002. http://www.cpao.embrapa.br/

Schnepf, Randall D.; Erik Dohlman, and Christine Bolling. *Agriculture in Brazil and Argentina: Developments and Prospects for Major Field Crops*. Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture, Agriculture and Trade Report, WRS-01-03, November 2001.

Shean, Michael J. *Brazil: Future Agricultural Expansion Potential Underrated*. USDA Production Estimates and Crop Assessment Division, Foreign Agricultural Service, January 2003. http://www.fas.usda.gov/pecad/highlights//2003/01/ag_expansion/index2.htm

Swenson, Andrew and Ron Haugen. *Projected 2003 Crop Budgets South East North Dakota*. Farm Management Planning Guide, Section VI, Region 6A, Fargo: North Dakota State University, Extension Service, December 2002.

Thompson, James. "Soybean Port Expands." *Corn and Soybean Digest*, April 2003, pp. 24-25.

U.S. Department of Agriculture (USDA). "Production, Supply and Distribution." http://www.fas.usda.gov/psd/Psdselection.asp.

Verdonk, Ron. *Brazil Oilseeds and Products Annual 2003*. USDA Foreign Agricultural Service, GAIN Report #BR3003, March 10, 2003. http://www.fas.usda.gov/scriptsw/attacherep/default.asp

White, Tamara. *IFB Argentina/Brazil Market Study Tour, February 8-19*. Illinois Farm Bureau. http://www.ilfb.org/viewdocument.asp?did=4170, October 23, 2002.

Wilson, William W., Won Koo, Bruce Dahl, and Skip Talor. *World Grain Trade and Panama Canal Expansion Alternatives*. Unpublished Report, Fargo: North Dakota State University, May 15, 2003. Contact bwilson@ndsuext.nodak.edu