

BEST MANAGEMENT PRACTICES

Chapter 56: Soybean Production Costs



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Understanding soybean production costs is the first step in optimizing your soybean management system. An interactive tool, the "2012 Risk Calculator," is available at <u>http://www.sdstate.edu/econ/extension/</u><u>index.cfm</u>. It will assist you in calculating your total costs and net returns. This chapter is focused on the analysis of South Dakota soybean production costs and changes in these costs over time. The analyses are based on county producers workshops conducted between 2009 and 2012 and may be different from actual budgets.

Soybean gross returns and total costs

Financial budgets are important to understand before committing resources to implementing a new plan. Each crop grown can be considered as an enterprise, and a budget can be realized to provide an estimate of the potential revenue, expenses, and profit. The base unit is typically one acre for crops. Budgets help identify the most profitable crop to be included in the whole farm plan. Table 56.1 is used to discuss the content and components of a crop budget. In the following discussion, the soybean production budget is separated into several categories that include gross returns, total direct costs, total costs, and returns to management and labor.

- **Gross returns** or revenue are the long-term average return assumed to be earned before deducting management fees and other expenses. It is the total revenues from grain or hay sales, insurance indemnities, and government payments.
- Total direct costs are all the variable costs associated with production; seeds, fuel, fertilizers, chemicals, and so forth. Total costs are total direct costs plus land charge and machinery ownership costs.
- **Returns to management and labor** or profit are the net returns after deducting all expenses from the gross returns. Everyone is interested by this last value, and therefore it is important to interpret it correctly. The first step in constructing a crop financial budget is to determine agronomic practices, type and level of inputs, etc. All of the agronomic, technical, and production decisions have to be made before realizing the crop budget.

- The **gross returns** include all cash and non-cash revenue from the crop. Some crops have several sources of revenue, and therefore all should be included. For example, both corn grain and stover can be harvested. Both revenue streams should be included in the budget. The accuracy of the estimated profit highly depends on the accuracy of this section. Yields and price estimates should be as accurate as possible.
- **Projected yields** are based on historical yields or yields trends from the concerned state or the county.
- The **appropriate selling price** depends if the budget is only for the next year planning or for longterm purposes. Historical prices levels, price trends, and futures markets prices adjusted for local basis are often used.
- The **direct costs** are the costs that are induced only if the crop is produced. Table 56.2 shows the details of the production inputs for soybean and corn in 2011.
 - ▶ The costs of **seed**, **fertilizers**, and **pesticides** are easy to calculate, once the level of input has been decided.
 - ▷ The **crop insurance** is found depending on the kind of insurance a producer will choose, either yield insurance or revenue insurance.
 - Machinery costs (operating) are difficult to estimate. A method must be chosen to estimate the amount of repair expenses relative to the type of machinery, and the amount of use. Some tools exist to help farmers estimate these costs; the Iowa Custom rate is one example and can be found for a given year at <u>https://www.extension.iastate.edu/agdm/crops/html/a3-10.html</u>. The cost of fuel and lubricants should not be forgotten in those estimates.
 - ▷ The **cost of labor** should also be included. It depends on the crop production and on the size of the machinery used and the number of machinery operations. The opportunity cost of farm operator is normally used to value labor.
 - ▷ The operating interest is the last direct cost included in the budget. For soybeans or corn, it is generally less than a year from the time of the expenses until harvest when income is received. Interest is charged for a period of less than one year. Even if no capital is borrowed, there is an opportunity cost on the farm operator's capital. A weighted average of the interest rate on borrowed money and the opportunity cost of the farmers operating capital are used to estimate the operating interest.

All of these costs are summed and described as total **direct costs** per acre. Return over direct costs is the value of total direct costs subtracted from the gross returns. The last part of the budget is the total costs. It includes direct costs in producing a crop and the other costs that exist even if the crop is not grown. Land charge and machinery ownership costs are added to the direct costs. Land charge can be calculated several ways: the cost to cash rent similar land, the cost of a share rent lease for this crop on similar land, or the opportunity cost of the capital invested in the owned land. The estimated **net returns** are found by subtracting total costs from gross returns.

Soybeans are often grown in rotation with corn. In this case, budgets should be developed for each crop and the ownership costs divided between the two crops. Storage, marketing, and transportation are not included in this budget because they are not considered as a production decision, but rather a marketing decision. Crop enterprise budgets can be used to determine:

- The cost of production is the average cost of producing one unit of the commodity. It is determined by dividing the total cost by the estimated yield. In Table 56.1, the estimated soybean costs in 2012 was \$10.38/bushel. This cost changes annually. A profit is realized when the crop is sold at higher price than the cost of production.
- The breakeven yield or prices. The breakeven yield is calculated by dividing total cost by the selling price. The breakeven yield is the yield necessary to cover the cost of production. For example, in 2012 the cost of production was \$415.06/acre and the expected selling price was \$12.6/bu. Based on these values, the breakeven yield was 33 bushels/acre.

Gross returns	2009	2010	2011	2012
Estimated yield (bu)	40.00	40.00	40.00	40.00
Estimated selling price (\$/bu)	8.02	8.28	12.90	12.60
Value/acre	328.00	331.20	516.00	504.00
Other income/acre				
Gross return (\$/acre)	328.00	331.20	516.00	504.00
Direct cost (\$/acre)				
Seed (\$/a)	52.50	52.50	52.50	56.00
Fertilizer (\$/a)	33.55	18.11	30.27	48.12
Herbicide (\$/a)	20.39	15.28	15.28	17.88
Insecticide (\$/a)		3.81	3.81	4.20
Fungicide				
Crop Insurance (\$/a)	25.00	25.00	25.00	17.25
Machinery (\$/a)	43.00	28.00	38.00	50.00
Drying				
Operating interest (\$/a)	10.47	8.56	9.48	11.61
Other costs				
Total direct costs (\$/acre)	184.91	151.26	174.34	205.06
Return over direct costs (\$/acre)	143.09	179.94	341.66	298.94
Total direct cost/bushel (\$/acre)	4.62	3.78	4.36	5.13
Machinery ownership costs (\$/acre)	45.00	45.00	51.00	60.00
Land changes (\$/acre)	102.00	102.00	110.00	150.00
Total cost/acre (\$/acre)	331.91	298.26	335.34	415.06
Breakeven value (\$/bu)	8.30	7.46	8.38	10.38
Return to management (\$/acre)	-3.91	32.94	180.66	88.94
Breakeven yield (bu/acre)	40.00	36.00	26.00	33.00

 Table 56.1. Estimated South Dakota soybean production costs and return to labor and management from

 2009 to 2012. This calculator is available at http://www.sdstate.edu/econ/extension/index.cfm.

 Table 56.2. Costs estimates for crop budgeting in 2011. Left: Production inputs for soybeans. Right: Production inputs for corn. (Source: SDSU Extension)

ltem	Quantity	Price	Unit	С	Cost/ ac	
Seed	150.0	0.35	1,000	\$	52.50	
Fertilizer (lbs)				\$	30.27	
N	11.0	0.48	lbs			
N			lbs			
Р	52.0	0.48	lbs			
К		0.38	lbs			
			lbs			
			lbs			
Herbicide				\$	15.28	
Select	4.0	1.29	OZ			
Roundup	44.0	0.23	OZ			
Insecticide				\$	3.81	
Baythroid	2.8	1.36	0Z			
Fungicide				\$	-	

ltem	Quantity	Price	Unit	Cost/ac
Seed	25.0	3.07	1,000	\$ 76.75
Fertilizer				\$ 118.90
Ν	180.0	0.48	lbs	
Ν			lbs	
Р	60.0	0.48	lbs	
К		0.38	lbs	
Lime			lbs	
Zinc	1.0	4.00	qt	
Herbicide				\$ 20.02
Harness Extra	1.2	8.25	qt	
Roundup	44.0	0.23	0Z	
Insecticide				\$ -
Fungicide				\$ -

South Dakota soybean production costs

By tracking changes in costs and net returns, farm investment options can be explored. A tool for conducting this analysis is available at http://www.sdstate.edu/econ/extension/index.cfm. This analysis showed that:

- 1. On average from 2009 to 2012, soybean production costs increased from \$331.91 to \$415.06 per acre. This increase was attributed to many factors including higher costs for fertilizer, land, and machinery (Table 56.1).
- 2. The major annual production costs were for seed, fertilizer, and chemicals, which increased from \$106.44 in 2009 to \$126.20 in 2012. Most of the remaining costs were for machinery operations, machinery ownership, and land costs (Table 56.1).
- 3. In soybean production most of the fertilizer cost was associated with purchasing P fertilize, herbicides were Select[®] and Roundup[®], while insecticides were baythroid (Table 56.2).
- 4. In corn production, fertilizer costs were associated with N, P, and zinc, and herbicide costs were associated with harness extra and roundup (Table 56.2).

To further assess production cost changes across different localities, Mr. Donald Guthmiller, SDSU Extension, conducted a production survey in 2011 and 2012 (Fig. 56.1) in 13 different counties. Most participants were located in eastern South Dakota. Several differences can be seen across counties (Fig. 56.1):

- 1. In 2011, the lowest soybean total costs per acre (\$304.48/acre) were in Clark County, and in 2012 the highest costs per acre (\$403.40/acre) were in Deuel County.
- 2. Large variation in county yields, which ranged from 35 to 48 bushels /acre, affected net returns.
- 3. In 2012, projected return to management and labor varied from near \$0 in Grant County to over \$150/ acre in Minnehaha County.



Figure 56.1. Comparison of soybean production costs in several counties in 2011 and 2012. (Source: Based on producer workshops conducted by Donald Guthmiller, SDSU Extension)

The details of the soybean production costs across counties are shown in Figure 56.2. This analysis shows that in 2012: 1) seed costs were relatively stable across counties; 2) fertilizer prices varied from \$23.4/acre to \$37.12/acre; and 3) land rental costs varied from \$60/acre in Hughes County to \$155/acre in Brookings and Day counties.



Figure 56.2. Breakdown of soybean production costs in several counties in 2011 and 2012. (Source: Based on producer workshops conducted by Donald Guthmiller, SDSU Extension)

The amount of gross returns, direct costs, total costs, and returns for labor and management were influenced by the location (Fig. 56.3). In 2011, the highest return to management and labor was in Brown County and the lowest return was in Clark County. Slightly different results were observed in 2012 where the highest returns were in Minnehaha County and the lowest returns were in Grant County.



Figure 56.3. Gross returns, operation costs, total costs, and net returns for soybean production in 2011 and 2012. (Source: Based on producer workshops conducted by Donald Guthmiller, SDSU Extension)

Yields of corn, similar to soybeans, vary a lot depending on the county, from 130bu/acre in Hughes County to 180bu/acre in Kingsbury, Hamlin, and Brookings counties; therefore, the gross return for corn production is also really different from \$936/ acre in Hamlin County to \$627/acre in Roberts County.

Seed costs were stable across counties, while fertilizers costs ranged from \$123/acre to \$160/acre. The other main factor of variation across counties is the land charge. The variation is much higher than for soybean, from \$60/acre in Hughes County to \$250/acre in Minnehaha County, which is more than four times higher. This difference in land charge across counties explains most of the difference in total cost and therefore in net returns.

Changes in soybean production costs from 1980 to 2012

From 1980 to present, soybeans have become a major South Dakota crop. In 1980, soybeans were harvested from 770,000 acres and production value was \$144 million. In 2011, South Dakota farmers harvested 4.1 million acres of soybeans and production value was \$1.716 billion, second only to corn acres and productions value. From 1980 to 2011, South Dakota farmers harvested nearly 3.33 million more soybean acres and production value had increased by 12-fold (USDA-NASS). Factors that contributed to increased soybean production include strong soybean prices, low production costs, and that soybeans fit into the production system.

The widespread adoption of herbicide-tolerant varieties and low-till production practices helped keep soybean production costs low. This part presents the costs of producing soybeans in South Dakota and examines how these costs varied from 1980 to 2012, a 32-year-period. The budgets reported in Table 56.3 and Figure 56.4 were from crop planning budgets used by SDSU Extension Economists in the respective years. The planning budgets were usually developed in January using projected yields, prices, and production costs for the upcoming crop year.

	1980	1983	1985	1989	1993	1997	2000	2002	2005	2010	2012
Yield (bu/a)	18.5	30.0	28.0	28.0	29.0	31.0	36.0	36.0	40.0	40.0	40.0
State-wide Yield (bu/a)	26.0	26.5	32.0	26.0	22.0	35.0	35.0	31.0	35.0	38.0	30.0
Selling Price (\$/bu)	6.50	5.10	5.50	6.50	6.03	6.35	4.95	5.15	5.00	8.28	12.60
Total Revenue (\$/a)	120.25	153.00	154.00	182.00	174.04	199.43	178.20	185.40	200.00	331.20	504.00
Production Costs (\$/a)	81.85	122.60	117.50	104.87	116.31	108.22	95.80	103.40	108.56	196.26	265.06
Land Charges (\$/a)	28.50	37.40	32.25	33.75	41.25	56.22	56.00	57.00	65.00	102.00	150.00
Total Cost (\$/a)	110.35	160.00	149.75	138.62	157.56	164.44	151.80	160.40	173.59	298.26	415.06
Breakeven Price (bu/a)	5.96	5.33	5.35	4.95	5.46	5.24	4.22	4.56	3.96	7.46	10.38
Breakeven Yield (bu/a)	17.0	31.4	27.2	21.3	26.1	25.9	30.7	31.2	31.7	36.0	32.9
Net Income (\$/a)	9.90	3.00	4.25	43.38	16.48	34.99	0.59	31.49	26.41	32.94	88.94

Table 56.3. Summary of January soybean budgets for South Dakota from 1980 to 2012. (Source: SDSU Extension)



Figure 56.4. Changes over time in net income and costs of producing soybeans from 1980 to 2012. (Source: Data is from Table 56.3, SDSU Extension)

Over the last 32 years, several changes were noticeable. First, over time, gross income (total revenue) and total cost per acre have generally increased. Between years, however, this is not necessarily the case. For example, between 1980 and 1989 gross income increased, whereas from 1989 to 2005 gross income remained relatively stable. During the same period, total costs per acre peaked in 1983 and were relatively stable until 2005. Yields were trending upward so total costs per bushel were generally declining. From 2005 to 2012, total costs and gross income have increased rapidly. The two major reasons for temporal budget changes were the release of Roundup Ready[®] soybean cultivars, and the increasing demand for agricultural products.

The 1980 to 2012 time period (32 years)

From 1980 to 2012, soybean yields doubled from 18.5 bushels to 40 bushels (Table 56.4). Prices have followed the same trend and also nearly doubled from \$6.50/bu in 1980 to \$12.60/bu in 2012. Based on these changes, gross income increased by 319% in 32 years, while total costs increased by 276%, and net income over all costs increased nearly eight-fold. Much of the increase in total costs is attributed to land costs that increased from \$28.50/acre in 1980 to \$150/acre in 2012.

During this time period, production costs increased at a slower rate than land costs. The percentage change in the rate of inflation is included in the table below to compare the soybean costs figures to general price inflation that occurred in the economy. Between 1980 and 2012, inflation has increased by a total of 148%.

	Difference	% Increase
Yield	Bu 21.5	116%
Selling Price	\$ 6.10	94%
Gross Income	\$383.75	319%
Production costs (\$/ac, excluding land)	\$183.21	224%
Land charges (\$/ac)	\$121.50	426%
Total Cost (\$/ac)	\$304.71	276%
Breakeven Price (\$/bu)	\$4.41	74%
Breakeven Yield (bu/ac)	Bu 16.0	94%
Net Income over all costs (\$/acre)	\$79.04	798%
Infation (from 1980 to 2012)		148%

 Table 56.4. Analysis of soybean production budget variation between 1980 and 2012.

 (Data source from Table 56.3, SDSU Extension)

The 1989 to 2012 time period (23 years)

From 1989 to 2012, land costs increased 344%, non-land production costs increased by 153%, while yields increased by 43%. Over this time period, gross income increased from \$182/acre in 1989 to \$504/acre in 2012. Net income over all costs increased from \$43 to \$89 per acre. During this time period, inflation has increased by a total of 67%.

	Difference	% Increase
Yield	Bu 12	43%
Selling Price	\$6.10	94%
Gross Income	\$322.00	177%
Production costs (\$/ac, excluding land)	\$160.19	153%
Land charges (\$/ac)	\$116.25	344%
Total Cost (\$/ac)	\$276.44	199%
Breakeven Price (\$/bu)	\$5.43	110%
Breakeven Yield (bu/ac)	Bu 11.6	54%
Net Income over all costs (\$/acre)	\$45.56	105%
Infation (from 1989 to 2012)		67%

Table 56.5. Analysis of soybean production budget variation between 1989 and 2012.(Data source from Table 56.3, SDSU Extension)

The 2002 to 2012 time period (10 years)

Over the last 10 years production costs, gross income, and profits (net income) increased in most years (Table 56.6). Over this time period, soybean selling prices increased by 145% and projected yields increased 11%, which resulted in gross income increasing by 172%. During these last ten years, land charges and non-land production costs increased at similar rates (163% vs. 156%). Total costs per acre increased by 159%, while inflation only increased by 25%.

Soybean gross income and costs relative to inflation

During all three time periods examined, soybean gross income greatly exceeded the rate of inflation, primarily due to yield increases from the early 1980s to 2000 and from soybean price increases after 2005. Land charges were well above the inflation rate (except from 1983 to 1989). All other soybean production costs were lower than the inflation rate from 1980 to 2012, similar to the inflation rate from 1989 to 2012, and substantially above the inflation rate from 2002 to 2012.

(Data source from Table 56.3, SDSU Extension)		
	Difference	% Increase
Yield	Bu 4	11.1%
Selling Price	\$7.45	144.7%
Gross Income (\$/ac.)	\$318.60	171.8%
Production costs (\$/ac, excluding land)	\$161.66	156.3%
Land charges (\$/ac)	\$93.00	163.2%
Total Cost (\$/ac)	\$254.66	158.8%
Breakeven Price (\$/bu)	\$5.92	132.9%
Breakeven Yield (bu/ac)	Bu 1.8	5.8%

Table 56.6. Analysis of soybean production budget variation between 2002 and 2012.

Corn yields and returns from 1980 to 2010

Net Income over all costs (\$/acre)

Infation (from 2002 to 2012)

Corn yields and selling prices have increased rapidly over these last 30 years. Corn yields went from 53 bu/acre in 1980 to 135 bu/acre in 2010. Selling prices also increased from \$2.84/bu in 1980 to \$5.09/bu in 2010 (Fig. 56.5). Recent increases in the corn selling price are linked to ethanol production.

\$63.94

255.8%

25%



Figure 56.5. Changes from 1980 to 2010 in corn grain yields and selling price. (Source: NASS)

Historical data of cost and return estimates for corn, soybeans, wheat, cotton, grain sorghum, rice, peanuts, oats, barley, milk, hogs, and cow-calf are available at <u>http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx</u>. These cost and return estimates are reported for major production regions and for the United States, but not for individual states. South Dakota is included in the Great Plains production region. Costs of production forecasts are also available.

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