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Douglas R. Franklin
South Dakota State University

Eric S. Stebbins
South Dakota State University

Gene Murra
South Dakota State University

SDSU

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EVALUATION OF IRRIGATED AND NON-IRRIGATED CORN PRODUCTION IN BROOKINGS COUNTY

by

Douglas R. Franklin
Associate Professor
Eric S. Stebbins
Research Associate

South Dakota agriculture has undergone many changes in recent years. Producers are continuously adjusting to new farming practices to maintain a competitive position in expanding global markets. One adjustment is the increased use of irrigation in South Dakota. Irrigation is appealing because it expands income earning potential and reduces risks associated with drought conditions.

This Commentator will compare the simulated profitability of non-irrigated and irrigated corn production in Brookings County from 1984 to 1993 under ideal management conditions. Brookings County is located in the far east central area of the state. The county consistently ranks as one of the top corn producing counties in the state.

A crop simulation model, CERES-Maize, was used to generate agronomic data. The simulation model reflects specific geographic and weather conditions and cultural practices for corn production in Brookings County. The simulation process does not consider all environmental conditions (e.g., frost, hail, disease). The results of the study are based on the simulated model and not surveys or test plot data.

The first procedure of the study was the simulation of crop yields using CERES-Maize. Soil type (Estelline silt loam soil) and daily weather data (temperature highs and lows, precipitation, and solar radiation) were entered for the period from 1984-1993. Typical cultural practices,
(Continued on next page)

HOG COMMENTS

by

Gene Murra
Extension Economist/
Livestock Marketing

The Hog and Pig report, released on September 29th for conditions on September 1, was about in line with expectations. The total inventory of hogs was down 2 percent compared to a year ago. The market hog inventory was down 2 percent compared to a year ago. That should be neutral for the rest of this year. While slaughter levels should increase (a seasonal increase is normal) as we move into the Fall, the increase should be well below the record levels noted in the Fall of last year. That also should mean cash prices will be above the below-$30 level paid in October and November of last year. That does not mean early October prices in the upper $40's can be maintained. Look for prices in the $40-45 area, with below $40 certainly possible.

The breeding inventory was down 5 percent compared to last year. However, farrowing expectations for this Fall and Winter are equal to last year. That could be bad news for next year. Low prices and resultant losses by producers late in 1994 and early 1995 were the main reason for some cutting back. Also, high corn prices with higher breakevens this Fall promote liquidation.

Apparently, the strong cash market this Summer offset some of the pullback in numbers. Those higher prices could even promote expansion later this year and early next year. Hog producers can (and often do) change their minds. Large-scale producers still are becoming a more important part of the supply picture (and even the demand picture). What they do (sometimes maybe not totally captured in this Hog and Pig report) will play a big role in what happens.
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for both irrigated and non-irrigated corn production, were chosen. These variables are seed variety, row spacing, planting date, plant population (30,000 for irrigated and 22,000 for non-irrigated), and fertilization rates.

Crop budgets were generated to provide total production costs and breakeven costs based on the simulated yields. Expenses assumed to differ between irrigated and non-irrigated production covere seeds, nitrogen fertilizer, crop drying, labor, and irrigation equipment operation and ownership. All other expenses (e.g., overhead, fuel and lubrication, depreciation on machinery and equipment, real estate taxes) were assumed to not vary between irrigated and non-irrigated production. All of the expenses were summed to determine per acre production costs for irrigated and non-irrigated corn production. The simulated breakeven costs were calculated by dividing the per acre production cost by yield for each respective year.

Agronomic Results

CERES-Maize generated simulated yields for irrigated and non-irrigated corn for the ten year period from 1984 to 1993 (Table 1). Annual yields ranged from 6 bu./ac. to 164 bu./ac. for non-irrigated production and from 70 bu./ac. to 280 bu./ac. for irrigated corn production. The ten year average yield was 68 bu./ac. for non-irrigated production and 186 bu./ac. for irrigated production.

Table 1: Simulated non-irrigated and irrigated yields (bu/ac).

	Non-irrigated	Irrigated
1984	53	148
1985	31	153
1986	164	238
1987	91	280
1988	6	252
1989	123	201
1990	37	186
1991	53	240
1992	51	70
1993	67	96

The variation in non-irrigated yields is largely attributed to total precipitation available and the distribution of that precipitation throughout the growing season. Growing season precipitation ranged from 8.5 in. to 21.9 in. with a mean value of 14.3 in. The three years which had the lowest non-irrigated yields, 1985, 1988, and 1990, were the three years in which the cumulative water stress factor was high during the silking to begin grain fill stage.

The importance of receiving rainfall in a timely manner was apparent throughout the study. For example, during the 1990 growing season, 15.2 in. of rainfall was received and the cumulative heat unit factor, CDTT, was 1511. During the 1989 growing season, 12.8 in. of rainfall was received along with a CDTT of 1440. The 1990 growing season had more rain and solar radiation, yet the non-irrigated yield was 37 bu./ac. compared to 123 bu./ac. for the 1989 season. The main difference was the distribution of rainfall received. The 1990 growing season received the bulk of its rainfall during the early part of the growing season (May and June). During the 1989 growing season, rainfall was more evenly distributed and adequate precipitation was received during the critical growth stages of the crop. This created a lower moisture stress level during these critical stages and resulted in a much higher yield.

Variability of yields in irrigated production is different from that associated with non-irrigated yields. Irrigation limited moisture stress throughout the growing season. Rainfall and irrigation ranged from 18.7 in. to 26.4 in. with a mean value of 22.0 in. during the study period. Thus, factors other than moisture stress influencing yield and variability of yield across the ten year period.

The cumulative heat factor, CDTT, for the growing season had a major influence on yield variability. The CDTT factor is associated with temperature and solar radiation. The CDTT values ranged from 1233 to 1718 with a mean value of 1487 over the ten year period. CDTT had two noticeable effects on irrigated production. First, as CDTT increased, total water needed (rainfall and irrigation) increased to compensate for higher evapotranspiration rates. The simulation model increased irrigation levels to compensate for the higher evapotranspiration rates. This was an effect of a higher CDTT, but not an effect which influenced yield variability.

The second effect involved lower CDTT levels. This factor influenced yield variability in irrigated production. When moisture stress is removed, the major limiting factor is associated with cool temperatures and low levels of solar radiation. The 1992 and 1993 growing seasons were unusually cool. These two years produced the lowest irrigated yields in the study. Moisture was available, but cool temperatures and low levels of solar radiation slowed crop development and in turn limited yield.

Irrigation Characteristics

Irrigation was used as a supplemental source of water throughout the ten year period. Table 2 illustrates irrigation as a supplemental water source over the study period. The average irrigated water applied was 7.37 ac-inches. Less than 10 inches of irrigation water was applied in 9 of 10 years. During four growing seasons less than 5 inches of irrigation was applied. The drought year of 1988 was the only year which relied heavily on irrigation to produce a crop.

Table 2: Irrigation water applied (acre-inches/acre).

1984	7.60
1985	7.53
1986	4.45
1987	8.78
1988	13.86
1989	5.91
1990	8.97
1991	9.09
1992	3.04
1993	4.45

Irrigation stabilized the variability associated with yields during the ten year period. This "stability" is reflected in the total water used by the crop in each year of the study. Total water usage represented by cumulative evapotranspiration, CET, is higher and more stable in irrigated production over the ten year period. The CET associated with non-irrigated corn varies considerably in the critical growth stages. This is a major reason for the wide variability of non-irrigated yields from one year to another.

Economic Results

The crop budgets can be used for determining breakeven corn costs. The corn prices used represent marketing year average corn prices based on monthly prices weighted by monthly marketings for the period from September through August each year. Prices in the analysis do not reflect any involvement in government programs.

Crop budgets were generated from 1984-1993. Breakeven corn costs were compared to average actual corn prices. Table 3 lists breakeven costs for non-irrigated and irrigated corn production and marketing year average corn prices. The severe drought year of 1988 which resulted in non-irrigated production of 6 bu./ac. distorts the breakeven analysis. Thus, two breakeven prices were calculated for non-irrigated corn: one with and the other without 1988 included.

Non-irrigated corn production breakeven costs were lower than the average corn price during only two of the ten years, namely, 1986 and 1989. The average non-irrigated corn production breakeven cost, excluding the drought year of 1988, was $2.88. This is considerably higher than the average corn price of $2.08 received during the ten year period.

Irrigated corn production breakeven costs averaged $1.75. They were below the average corn price seven of the ten years and the non-irrigated breakeven cost eight of the ten years.

Table 3: Breakeven and average corn prices.

Year	Breakeven Cost Non-Irrigated	Breakeven Cost Irrigated	Average Corn Price
1984	$3.90	$2.17	$2.45
1985	$6.46	$2.07	$2.07
1986	$1.30	$1.32	$1.37
1987	$2.16	$1.14	$1.92
1988	$30.93	$1.29	$2.38
1989	$1.76	$1.63	$2.14
1990	$5.49	$1.73	$2.08
1991	$4.12	$1.44	$2.16
1992	$4.46	$4.64	$1.84
1993	$3.70	$3.65	$2.40
1984-1993 Average			
1.	$3.13	$1.75	$2.08
2.	$2.88		

Note: (1.) includes 1988 year, (2.) excludes 1988 year

Conclusions

The effectiveness of irrigation, from an agronomic viewpoint, depends largely on geographical conditions and prevailing weather. Assessing the profitability relies heavily on market prices and input costs.

The analysis provided information that supports the use of irrigation. Given the characteristics of the Estelline soil type and prevailing weather conditions from 1984-1993, irrigated production was more profitable than non-irrigated corn production. In nine of ten years studied, per acre net returns were higher for irrigated than non-irrigated corn production.

The breakeven comparison between the two types of production showed that irrigated corn produced a lower

SOUTH DAKOTA STATE UNIVERSITY
Economics Department
Box 504A
Brookings, SD 57007

SDSU

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ten year average breakeven cost and less variability in the breakeven cost than non-irrigated corn.

This Economics Commentator is based on a South Dakota State University Economics Research Report 95-3 (Sept. 1995). Copies may be obtained by contacting the Economics Department.

(Hog Comments ... cont'd from p.1)

Hog & Pig Report
For September 1, 1995

	Average	Actual
Total Inventory	98	98
Breeding Inventory	96	95
Market Inventory	98	98

In South Dakota, the large inventory declines noted in the June Hog and Pig report were evident in this report. Total hog and pig inventories in the state were 1.55 million head on September 1 (down 16 percent versus 1994). The market hog inventory in South Dakota was set at 1.36 million head, also down 16 percent compared to last year. The state's breeding herd was only 190,000 head on September 1. That is 21 percent lower than for the same date last year. No other state (of the major 16) had decreases in inventory levels (in percentage terms) even close to those seen in South Dakota.

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ECONOMICS COMMENTATOR
EDITOR: Donald C. Taylor

ECONOMICS DEPARTMENT
South Dakota State University
Box 504A
Brookings, SD 57007-0895
Phone: (605) 688-4141
Fax: (605) 688-6386

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