Economic Analysis of Kansas Losses from Overuse of Republican River Water by Nebraska in 2005 and 2006

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November 18, 2011

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INTRODUCTION

This report describes the economic analysis of Kansas' losses resulting from Nebraska's overuse of Republican River water in the years 2005 and 2006. The Supreme Court entered its decree ("Decree") approving the Final Settlement Stipulation ("FSS") on May 19, 2003. The years 2005 and 2006 were water-short year accounting years under the FSS, and Spronk Water Engineers ("SWE") has quantified the amount of overuse by Nebraska in 2005 and 2006. SWE has also provided the amount of irrigation water that would have reached fields in Kansas in 2005 and 2006 but for Nebraska's overuse. In turn, Dr. Norman L. Klocke, has provided crop production functions that allow the yield losses in Kansas in 2005 and 2006 to be determined. This report then determines the economic value of those losses in present dollars. The economic value of those losses is composed of two parts, the direct, on-farm, economic effects and the secondary effects in the Kansas businesses and communities linked economically to those farms.

As shown in the SWE Report, water use in Kansas affected by the Nebraska overuse in 2005 and 2006 can be divided into two geographic areas: (1) the Kansas Bostwick Irrigation District ("KBID"); (2) outside KBID. Irrigated acreages within KBID are furthered divided into the area above Lovewell Reservoir and the area below Lovewell Reservoir.

ON-FARM DIRECT EFFECTS IN KBID

This section determines the on-farm direct economic effects suffered by Kansas farmers due to inadequate water supplies in 2005 and 2006. Calculating the direct economic effects requires calculating farmers' actual costs and returns in these two years. It also requires calculating what Kansas farmers' costs and returns would have been if Nebraska had not overused the Republican River supply, allowing Kansas farmers to receive the required water that would have been available.

KBID Irrigated Crop Acreage History

Tables 1 and 2 show KBID actual irrigated acreage, by crop, from 1991 through 2010. Table 1 refers to the portion of KBID served by water supplies above Lovewell and table 2 refers to the part of KBID that can be reached by water stored in Lovewell. These are the acreage numbers reported in the KBID annual reports (except as noted in the footnotes). The irrigated crops grown are based on returns from the KBID annual water user survey. The years 1991-93 and 2001-2009 were all water short, starting the irrigation season with water supply restrictions. However the focus of this case is on 2005 and 2006, two of the years when Nebraska failed to restrict its consumptive water use as required under the Decree, causing irrigated acreage reductions in KBID both above and below Lovewell.

Irrigated Crops in KBID with the Required Water Supply

Tables 3 and 4 show the crop mix percentages for 1991 through 2010. Figures 1 and 2 present the crop mix percentages as graphs. Early in the time period corn was the dominant crop.

Through time corn became less dominant as soybeans played a larger role in the crop mix. While minor crops, the percentage of land devoted to milo and alfalfa did increase in the water short years. The crop mix has been stable in recent years, with no strong trends.

This analysis requires determining the irrigated crops Kansas would have grown if the required water supply had been available in 2005 and 2006. The first step is to calculate how much land would have been irrigated in 2005 and 2006 if the required water supply had been available. This is done in tables 5 and 6. Based on the KBID annual reports, table 6 tabulates the total acres that were "classified" as irrigable and eligible to receive irrigation water, and the total acres that were actually irrigated, by year. As reported in table 5, the percentage of classified acres that were actually irrigated ranged from 82 to 95 percent in 1994 through 2000, years when the water supply was sufficient enough that the year did not begin with water supply restrictions. The percentage irrigated can depend on things such as crop market conditions and soil moisture at the start of the season. In contrast the percent of classified land that was irrigated dropped to 53.4 percent in 2004 and 57.0 percent in 2005 as a result of the water shortage. The 1994 to 2000 period best represents the percent of classified land which would have been irrigated in 2005-06. This results in an average figure of 89.1 percent of the classified acres that would have been irrigated in 2005-06.

Table 5 also shows the distribution of this irrigated acreage between the KBID parcels above and below Lovewell. The annual report numbers show the historic percent division above and below Lovewell. Again the years1994 through 2000 (without start of year water restrictions) best represent the division that would have occurred in 2005 and 2006 if the required water supply had been available. The 1994 to 2000 average, 33.7% above and 66.3% below Lovewell, is chosen to represent the percentages above and below Lovewell in 2005 and 2006.

Table 6 completes the calculation. The classified acreage was 43,100 acres in 2005 and 43,048 acres in 2006. Taking 89.1 percent of classified acres as irrigated, and allocating this between above and below Lovewell gives the acres that would have been irrigated in 2005 and 2006. For 2005 this gives 12,962 acres above Lovewell and 25,448 acres below. The classified acres decreased slightly from 2005 to 2006, resulting in 12,946 acres above Lovewell and 25,417 acres below in 2006.

An appropriate crop mix must be selected in order to determine the irrigated crops that would have been grown with the required water supply. Tables 2 and 4 showed the annual crop mix both above and below Lovewell. The years 1994 through 2000 did not start with water supply restrictions, so might be taken as representative of the appropriate crop mix. However figures 1 and 2 show that this was a period when the crop mix was changing. Corn was losing its absolute dominance – falling from over 95% of the acreage in 1992 to a 55 to 60 percent range in 2000. The soybeans share of acreage was increasing – from under 5% in 1992 to over 40% in 2000. The only year in the data set which did not begin the irrigation season with restrictions and was not a year when crop mix was in flux is 2010. Hence 2010 was selected to represent the crop mix percentage that would have been grown in KBID in 2005 and 2006 had the required water supply been available.

Allocating the irrigated acreage among the crops that would have been grown had the required water supply been available is completed in table 7. The crop mix percentages for 2010 represent the crop mix that would have been grown if the required water supply had been available in 2005 and 2006. The acres that would have been irrigated are computed using these percentages and the acreage totals from table 6.

Prevented Planting in KBID

Because KBID is located in an area where dryland crops are feasible, when KBID farmers were faced with a shortage of irrigation water in 2005 and 2006, they were forced to switch to non-irrigated alternatives. The alternative of dryland crops is discussed below. However, KBID farmers had one additional option in the water short years of 2005-06. Instead of growing dryland crops, many farmers qualified for a program called "prevented planting". Prevented planting is part of the federal crop insurance program, and provides farmers with an indemnity payment if there is some natural event general to the area that prevents them from planting crops in a timely fashion. Prevented planting gives the farmers a further choice. They can either leave the land fallow, or they can grow a non-program crop which they harvest for forage. (They cannot, for example, receive a prevented planting payment for irrigated corn, and then grow dryland corn.) In other areas of the United States, prevented planting payments are commonly made to farmers because unseasonably wet or cool spring weather prevents timely planting. In KBID, prevented planting payments were made to farmers in 2005 and 2006 because the district-wide irrigation water shortage prevented planting of irrigated crops.

Table 8 summarizes the acres of prevented planting and indemnity payments for Jewell and Republic Counties for each of the two years. The boundary between Jewell and Republic counties does not correspond to the boundary between above and below Lovewell. The total prevented planting in the two counties is allocated between above and below Lovewell based on the amounts of non-irrigated land above and below Lovewell.

Dryland Crops Grown in KBID Because of Water Shortage

There is no KBID-specific data on the dryland crops actually grown on KBID lands because the KBID annual water user survey only covers irrigated crops. Instead, this analysis calculates what crops would have been grown using available information on dryland crops grown in the Jewell and Republic County area that encompasses KBID. The United States Department of Agriculture National Agricultural Statistics Service (NASS) uses survey methods to collect data on agricultural production by county across the entire United States. NASS data are widely used for agricultural economics research and policy analysis. Table 9 presents the NASS data by crop, county and year. The county crop mix percentages are shown in table 9, along with a weighted average crop mix, weighted according to the KBID acreage in each county.

Table 10 shows that in 2005 below Lovewell 25,448 acres would have been irrigated, but only 23,439 acres were actually irrigated (at a reduced application rate). The difference, 2,009 acres, had to switch to dryland alternatives because of the water shortage. Because the area above Lovewell received very little irrigation water in 2005, of the 12,962 acres that would have been irrigated only 1,107 actually received any water, leaving 11,855 acres relegated to non-irrigated

alternatives. The prevented planting acres are then entered into table 10 and deducted from the total acreage of dryland alternatives – leaving the acreage that was planted to dryland crops – 9,858 acres above Lovewell in 2005 and 1,670 acres below.

Table 9 includes acres and percentages of land devoted to wheat, one of the very important non-irrigated crops in the region. However the wheat grown in Kansas is spring wheat – which is planted in the fall. The implication is that by the time KBID farmers know that the following year will be water short it is too late to plant spring wheat. Thus, the bottom lines of table 9 show the crop mix percentages without wheat. Using these percentages, table 10 completes the calculation of the acreages of dryland crops that were actually grown in KBID.

Table 11 summarizes the acreage allocations for the two scenarios – the irrigated and dryland crop acres that were actually grown in 2005-06, and the acreage of irrigated crops that would have been grown in these years if the required irrigation water supply had been available.

Note that several of the crops in table 12 and subsequent tables have been aggregated to simplify the presentation and analysis. The acreages of silage and sunflowers are very small -- so the silage acreage has been included in the corn acreage, and the sunflower acreage in the milo acreage. This aggregation is carried forward to the conclusion of this analysis.

Crop Yield Effects

The irrigation water shortage experienced by KBID had measurable effects on crop yields in 2005 and 2006. These yield effects are computed as part of this analysis. The KBID annual reports include irrigated crop yields based on their irrigated crop survey, but although KBID management personnel indicated that most of the larger farmers returned the survey, the representativeness of the responses could be questioned. The KBID irrigation survey gives no information on yields for crops grown without irrigation.

In the absence of authoritative irrigated yield data this analysis used a yield model described in the expert report by Norm Klocke. Following Klocke, yields are calculated according to the following equations:

$$Y = Y_n + (Y_f - Y_n)\,[\,1 - (\,1 - D/D_f)^{1/\beta}\,] \text{ where } \beta = (ET_f - ET_n)/D_f \qquad (1)$$

The equation also can be written as:

$$Y = Y_n + b\,(ET_f - ET_n)\,[\,1 - (\,1 - D/D_f)^{1/\beta}\,] \text{ where } b\,(ET_f - Et_n) = (Y_f - Y_n) \qquad (2)$$

The second form of the equation was used in developing the crop production function for north central Kansas

"**Y**" is the unknown grain yield (dependent variable) that is derived with equation 2.

"**D**" is the amount of irrigation (independent variable) that is delivered to the field.

"D_f" is the amount of irrigation required to produce maximum yield. **Net irrigation requirement** (NIR) is the infiltrated irrigation water that is necessary to produce maximum yield. It depends on geographic location (particularly precipitation) and crop. NIR requirement varies with rainfall probabilities; hence, location is important. D_f can be derived from NIR by dividing NIR by application efficiency (AE).

"Y_n" is the non-irrigated yield that is produced from precipitation only. Values for Y_n are the result of growing summer row crops that were not irrigated the year before. County yield averages for dryland crops, reported by NASS, include crops that may have followed the same or another row crop or the crop may have followed winter wheat. The typical 3-year dryland crop rotation across the Republican River Basin is winter wheat followed by sorghum or corn followed by fallow from harvest of sorghum or corn until wheat planting. Dr. Martin derived values for Y_n from a crop simulation model explained later in this report.

"Y_f" is the maximum yield that a crop can produce if unrestricted by inputs including irrigation, fertilizer, and chemicals for weed control and insect control.

"**b**" is the slope of the yield-evapotranspiration (ET) function that has been proven to follow a linear model by many field studies. ET is the combination of the water consumed by the crop, transpiration (T) and water evaporated directly from the soil surface (E). The form of the yield-ET function is (Martin et al., 2010):

$$Y = Y_n + b\,(ET - ET_n) \qquad (3)$$

"**ET_f- ET_n**" or "**ET-increase**" (ET_{inc}). ET_f is the amount of water used by a fully irrigated crop for maximum yield. ET_n is the amount of water used for plant growth when the crop produces no yield. ET_{inc} is the difference between ET_f and ET_n, which is the amount of water used by the crop to produce yield. Yield is grain produced in the case of grain crop and forage in the case of forage crops such as alfalfa.

"β" is the value for the exponent in equations 1 and 2. It influences the curvilinear shape of the yield response to irrigation and is related to application efficiency (AE), the ability of the irrigation system to deliver water to the soil surface.

$$\beta = AE\,(ET_{inc}/NIR) \qquad (4)$$

Table 12 presents the crop water application rates used to calculate the yields. Dryland crops receive no water. The actual water and required irrigation application rates are taken from the Spronk Water Engineers expert report. For example in 2005 land above Lovewell actually received 6.1 inches of water for 1,107 acres (table 11) that were actually irrigated. Lands above Lovewell would have received 10.5 inches for each of the 12,962 acres (table 11) that would have been irrigated if the required water supply had been available.

Table 13, adapted from table 1 in Klocke's report, shows the parameter values that drive the crop yield model as it is used to calculate KBID crop yields. Table 14 uses the yield model and

parameters provided by Klocke to calculate yields for irrigated crops that would have been grown had the required water supply been available, crops irrigated with the amount of water actually available, and dryland crops. These computed yields are inputs to the crop budget analysis which follows. These computed yields distinguish between year, application system and location above and below Lovewell.

To illustrate the use of the yield equation, the 2005 yield for pivot irrigated corn above Lovewell is computed using the parameters from table 13, and the 10.5 inches (table 12) of irrigation which this crop whould have gotten if it had received the required water:

First the slope of the yield – ET relationship is determined

$$b = (Y_f - Y_n) / (ET_f - Et_n) = (Y_f - Y_n) / (ET_{inc})$$

$$= (182 - 98) / 7.5 = 11.2$$

Next the gross irrigation required to produce maximum yield is computed

$$D_f = NIR/AE$$

$$= 10.1 / 0.85 = 11.88$$

And the value of β is determined

$$\beta = AE\ (ET_{inc}/NIR)$$

$$= .85\ (7.5 / 10.1) = 0.631$$

The parameter values are plugged into the yield equation

$$Y = Y_n + b\ (ET_f - ET_n)\ [1 - (\ 1 - D/D_f)^{1/\beta}\ ]$$

$$Y = Y_n + b\ (ET_{inc})\ [1 - (\ 1 - D/D_f)^{1/\beta}\ ]$$

$$= 98 + 11.2 * 7.5 * [1 - (1 - 10.5/11.88) \wedge (1 / 0.631)]$$

$$= 98 + 84 * [1 - (1 - 0.884) \wedge 1.585]$$

$$= 98 + 84 * (1 - 0.116 \wedge 1.585)$$

$$= 98 + 84 * (1 - 0.033)$$

$$= 98 + 84 * 0.967 = 98 + 81.23 = 179.2 \text{ bushels per acre}$$

The 179.2 bushels per acre is the 2005 yield for pivot irrigated corn above Lovewell with 10.5 inches of irrigation shown in table 14. Yields for the other combinations of crop, system type, location above and below Lovewell, and irrigation application rate are also shown in table 14.

Crop Budget Analysis

Tables 15 through 18 display numbers that are needed to do the crop budget analysis which follows. Table 15 summarizes the crop yields as computed in table 14. Table 16 presents crop prices from NASS, which were used in the crop budget analysis.

Crop cost and return budgets are prepared by many land grant university agricultural extension programs each year. The primary purpose of these crop budgets is to help farmers and others make better management decisions. These crop budgets also provide a source of crop cost and return information for researchers dealing with farm economic issues. The Kansas crop budgets prepared by Kansas State University (KSU) for 2005 and 2006 are used as a source of crop cost and return information in this analysis.

Farmers in KBID mainly use two irrigation application systems, sprinklers (mainly center pivot) and furrow (mainly gated pipe). Table 18 shows the breakdown between sprinkler and furrow systems in 2010. The last previous report of KBID irrigation systems was included in the 2006 KBID annual report, but the 2010 numbers were used because of concerns that the 2005-2006 water shortage could have skewed the 2006 percentages. In table 18, minor acreages of drip irrigation were aggregated into "pivot", and ditch (presumably siphon tubes) was aggregated with gated pipe, and is henceforth referred to as "furrow". Both above and below Lovewell the split between pivot and furrow application systems is not far from 50/50.

Tables 19 through 28 show the crop budgets developed for this analysis. Gross crop costs and returns vary depending on crop, application system, year, amount of water applied, and different yields above or below Lovewell. Therefore, each of these situations requires a separate budget. The crop budgets are used to compute two values, the spending on produced inputs, and value added. Produced inputs are items that are purchased and used by the farm such as fuel, seed and fertilizer. Value added is what is left over after produced inputs are paid for. Value added is the measure of net farm income used in this analysis, and includes returns to labor, an allowance for depreciation, and returns on invested capital.

Table 19 illustrates how this is done for corn above Lovewell. Table 19 contains four base budgets based on selected 2005 and 2006 KSU crop budgets. The KBID budgets are derived from these four base budgets. KSU base budget MF-2601 refers to center pivot irrigated corn in northcentral Kansas. KSU produced versions of MF-2601 for 2005 and 2006. KSU base budget MF-2161 refers to dryland corn in northcentral Kansas. Again, there are versions of MF-2161 for both years. Each of the original KSU budgets also showed three budget variants, a low yield budget, a middle yield variant and a high yield variant. The high yield corn budget variants were selected for use as most consistent with the yields encountered in this analysis.

KSU constructed their corn budget costs for fertilizer and lime, machinery expenses, and crop drying, by making these costs linear functions of yield. For example the 2005 pivot corn budget

low, medium and high yields were 145, 160 and 175 bushels per acre. The corresponding fertilizer costs were $63.66, $70.56, and $77.50 per acre. The fertilizer marginal cost across this yield interval is:

($77.50 - $63.66) / (175 bu – 145 bu) = $0.4613 per bushel

That is, 0.4613 is the slope of the linear function relating fertilizer cost to yield changes from the base yield. This function was then used to compute fertilizer costs for the KBID budgets. For example the 2005 KSU base pivot budget fertilizer cost with 175 bushel yield is shown in table 19 as $77.50. The 2005 KBID irrigated pivot budget fertilizer cost with the required water supply and the resulting yield of 179.2 bushels per acre is computed as:

$77.50 + (179.2 bu – 175 bu) * $0.4613 = $79.45 per acre

This $79.45 fertilizer cost is shown in table 19. The parameters used to make these adjustments and those below can be seen in the electronic spreadsheet versions of the budgets.

This analysis required that the cost of the machinery produced inputs (machinery maintenance and repairs and machinery fuel) be identified for each budget. The crop budgets developed by KSU for 2005 and 2006 based total machinery costs on the cost of custom hiring all machinery operations. Results from a MS thesis by Aaron Beaton were used to apportion this total machinery expense into costs of fuel and the cost of maintenance and repairs. Based on Beaton's work, the percentage of total machinery expense that is fuel, and the percentage that is repairs and maintenance, is shown in table 17.

Total 2005 machinery costs for the KBID pivot corn base budget above Lovewell (179.2 bushel per acre yield) are computed by adjusting the KSU base budget (175 bushel per acre yield) costs by the linear function of yield differences. (The $90.65 per acre base machinery cost and the 0.281 slope of the linear function are shown in the electronic version of the spreadsheet.). The computed pivot irrigated KBID corn budget total machinery cost is:

= $90.65 + (179.2 bu - 175 bu) * 0.281 = $91.84

The total machinery cost is allocated into fuel costs using the 11.8 percent figure from table 17:

= $91.84 * 11.8 percent = $10.84

as shown in table 19.

Similar linear function calculations were used to adjust costs machinery repair and maintenance costs and crop drying costs to the yield levels relevant to this analysis. The crop drying cost adjustments are proportional to yield using the per bushel costs provided in the KSU base budgets.

All the KSU irrigated crop budgets were based on center pivot irrigation systems with wells. In the KBID service area, the water is delivered by canals, not from wells, so this required an

adjustment to remove the investment cost of wells from the budget assumptions. The furrow irrigated budgets required a similar step to adjust the application system cost to reflect the investment in furrow systems. The irrigation system investment assumptions used are shown in the sub-tables shown in the spreadsheet below the body of the budget tables. These were computed using information obtained from table 1 of the report University of Arkansas (UA) Extension Publication # FSA28, titled "Estimating Irrigation Costs". Irrigation repair and maintenance costs are generally proportional to irrigation system investment system costs. For pivot irrigated corn above Lovewell in 2005 KSU base irrigation repair cost for pivot systems with wells was $0.33 per inch of water applied. Based on the UA report, investment cost for a pivot system with well was $934 per acre, and $609 per acre with a surface water supply. For irrigated pivot corn with the indicated 10.5 inches application, 2005 irrigation repair costs are:

= $0.33 per inch * ($609 per acre / $934 per acre) * 10.5 inches
= $2.26.

Similarly, the irrigation energy costs for the KSU base budget are $3.00 per inch of applied irrigation. Irrigation pumping energy costs are roughly proportional to the size and investment cost of the irrigation power unit. Based on the UA report, power unit investment costs are $94 per acre with a well and $66.67 for surface water delivery. For the irrigated pivot corn example with 10.5 inches of irrigation, energy costs are:

= $3.00 per inch * $66.67 per acre / $94 per acre * 10.5 inches
= $22.34.

The purpose of the crop budgets is to allocate crop gross revenue between spending on produced inputs and value added or income. The spending on produced inputs (such as seed, fertilizer, fuel, etc.) will be used to calculate the backward (secondary) economic linkages to the distributors and producers of these inputs. Value added, which includes returns to labor, profits, depreciation and returns on investment, is the measure of direct on farm income used in this analysis. Value added, calculated by subtracting total spending on produced inputs from crop gross revenue is the bottom line of the table. Total spending on produced inputs, appears in the line above value added in table 19. Total spending on produced inputs will be used below to compute secondary impacts. Tables 20 through 28 complete the set of crop budgets for all four crops and for above and below Lovewell.

Note that tables 23 and 28 are budgets for prevented planting. The indemnity payments which appear as part of gross returns from prevented planting come from table 8, based on information from RMA. Another document obtained from the RMA production request helps identify the premium cost farmers paid to participate in the prevented planting crop insurance program. The numbers from this source appear in the right-most column of table 8 -- showing the total indemnity and premium payments for Jewell and Republic Counties. The table also shows that the premiums averaged 17.7 percent of indemnity payments. Using the 17.7 percent figure indicates that premiums would have been $31.89 per acre in 2005 and $42.53 in 2006.

The prevented planting budgets use the 17.7 percent approach (the $31.89 per acre in 2005 and $42.53 in 2006) as the cost of enrolling in the prevented planting crop insurance program. The

budgets also included some costs for minimal maintenance of the fallowed land. Half of the land was assumed to grow a dryland forage grass crop. KSU cane hay budget MF-997 was used as a base for these costs and returns.

Tables 29 through 32 consolidate the results of the budget analysis. The four tables refer to each year and to above and below Lovewell. Each table has two sections. The top section refers to the irrigated and dryland crops that were actually grown because of water shortage. The lower section refers to the irrigated crops that would have been grown on this land if the required water supply had been available.

Near the top of each section are the acres corresponding to each crop budget. The acres are allocated between pivot and furrow application systems according to the prevalence of these system types shown in table 18. For example in table 29, there were 568 acres of corn grown with the actual irrigation water supply in 2005 above Lovewell. Using the irrigation system type percentages from table 18, table 29 shows that 50.1 percent or 285 acres used pivot application systems, and 284 acres used furrow.

At the bottom of each column of a sub-table, the acres are multiplied by the value added per acre to give total value added, and acres are multiplied by per acre spending on produced inputs to give total spending on produced inputs. These are then summed in the right-most column to give an aggregate total of value added and spending on produced inputs. Similarly the aggregate gross return appears near the top of the right-most column.

For example, the irrigated and dryland crops actually grown above Lovewell in 2005 produced gross returns of $2.9 million, spending on produced inputs of $1.6 million and value added of $1.3 million (shown in the upper part of table 29). If this land had received the required water supply it would have produced gross returns of $4.6 million, spending on produced inputs of $2.7 million, and value added of $2.0 million (shown in the bottom half of table 29). The differences, $1.7 million in gross returns, $1.1 million in spending on produced inputs, and $0.6 million in value added are the direct impacts which Kansas suffered in 2005 because Nebraska failed to restrict its consumptive use of Republican River water as required by the Decree. Tables 30, 31 and 32 make similar computations for land below Lovewell in 2005 and for lands above and below Lovewell in 2006.

Table 33 collects these results by year for above and below Lovewell and sums the results to a KBID total. The results show that the absence of required irrigation water in KBID resulted in a direct loss of gross crop income of approximately $ 5.8 million. The loss of spending on purchased inputs totals approximately $3.8 million, and the direct loss of value added (i.e. income) totals approximately $2.1 million. Input-Output analysis will be used to trace the secondary effects that this lost spending on purchased inputs will have on the backward linked businesses in Kansas.

ON-FARM DIRECT EFFECTS OUTSIDE KBID

Tables 34 through 43 extend the analysis to irrigated lands outside KBID. If Kansas had received the required amount of irrigation water, it would have been applied to KBID lands and a

portion would have appeared downstream as return flows. Some would have been runoff from furrow and sprinkler irrigated land. Some would have been deep percolation below the crop root zone, intercepted by drains. Some would have been leakage from canals in the system. These return flows, when they reach the drains, small streams, and the Republican River outside KBID would have been available for diversion and use by irrigators outside the KBID system.

Quantifying how much of this water would have actually been diverted and used by irrigators outside KBID is complicated by Kansas Minimum Desirable Streamflow (MDS) rules. These rules shut off irrigation diversions junior to the priority date attached to MDS if river flow drops below some threshold. MDS restrictions were implemented in the Republican River in both 2005 and 2006, shutting off irrigation diversions with rights junior to MDS. In 2005 and 2005 irrigators with diversion rights senior to MDS were able to continue taking water from the river if there was any to divert. It is these senior right holders that could have made use of the additional return flows if Nebraska had restrained its consumptive use of water as required by the Decree.

Table 34 is based on Spronk Water Engineers analysis of water supply effects outside KBID. The table shows the average senior acreage and diversions from 1994 to 2004. Also shown is the actual irrigated acreage and diversions senior to MDS outside KBID in 2005 and 2006. Taking the 1994-2004 averages as representative of irrigators willing and able to make use of river water, then the difference between the 1994-04 average and the actual 2005 and 2006 figures represents the unmet willingness to use return flows outside KBID. Table 34 shows that 1,727 acre feet of additional return flow water would have been available for irrigation diversion in 2005 and 2,105 acre feet in 2006, and an additional 926 and 1,430 acres would have resumed diversion if KBID had received the required supply of water.

Table 35 lays out how the additional water would have been used. For example in 2005, 5,330 acres that actually diverted 8.2 inches would have increased its diversion to 10.3 inches. The additional 926 acres that didn't get any river water in 2005 would have been able to also divert 10.3 inches. In 2006, 4,826 acres would have increased irrigation from 8.1 inches to 10.3 inches, and an additional 1,430 acres could have moved from dryland to 10.3 inches of irrigation.

Table 36 shows the crop mix assumptions used in the outside KBID analysis. The crop mix that was used for lands receiving the required water supply is the same average 2010 average crop mix that was used for the KBID analysis. Actual irrigated crops use the same crop mix that was reported as actually grown below Lovewell in the KBID crop surveys for 2005 and 2006 (from table 4). Dryland crops use the same crop mix as in our KBID analysis (from table 9).

The crop yield estimation approach is identical to the approach used for the KBID analysis, and uses the same yield function parameters, but water application rates from table 34 appropriate to the below KBID lands. Table 37 shows the resulting yields for 2005 and 2006; for furrow and pivot systems; and for irrigation rates if the required water supply had been available, for actual irrigation rates and dryland conditions.

Tables 38 through 41 present the outside KBID crop budgets. The approach for building these budgets is identical to that used for the KBID analysis except that the yields and irrigation rates are specific to the assumptions for crops and water supply outside KBID.

Tables 42 and 43 collect the results for each of these budgets. Table 42 applies to 2005 and table 43 to 2006. The upper portion of each table refers to the irrigated and dryland crops that were actually grown in that year, and the lower portion refers to the irrigated crops that would have been grown if KBID had received the required water. At the top of each section are the acres grown of each crop. The acres are allocated between pivot and furrow irrigation based on the same percentages as were used for the below Lovewell KBID analysis (from table 18). Given the acres and the value added and spending data, the total value added and spending are computed, and appear as the right-most column of each block in tables 42 and 43. For example in table 42, gross crop revenues fell by $238 thousand from $2.23 million to $1.99 million as a result of the water shortage outside KBID. Spending on produced inputs fell by $103 thousand from $1.14 million to $1.04 million and value added fell by $135 thousand from $1.09 million to $955 thousand.

Table 43 shows that the 2006 water shortage caused losses to Kansas farmers outside KBID totaling $375 thousand in lost crop gross returns, $187 thousand in reduced spending on produced inputs and $188 thousand in lost value added.

TOTAL ON-FARM DIRECT EFFECTS IN KANSAS

Table 44 collects the results for KBID and the Republican River area outside KBID. It provides detail on the results by year, and for the above and below Lovewell areas. Summing all these effects gives the value added (i.e. income) lost to Kansas totaling $2,395,675, and a loss of spending on produced inputs of $4,037,802. The numbers in table 44 will be used in the analysis of secondary effects which follows.

KANSAS OFF-FARM SECONDARY LOSSES

The explanation of the secondary effects of Kansas damages will involve some terms that are probably unfamiliar to the non-economist. This section begins with an explanation of terms, and some examples.

Explanation of terms

Value Added

Following standard practice, we measure Kansas losses in terms of "value added." Value added is a broad measure of income, computed as the difference between what a producer receives from the sale of output and the cost of produced inputs. In an agricultural setting, it measures the value that on-farm "primary factors of production," land, labor and capital, add to the value of produced inputs. The sum of all the value added by the various industries in a state economy equals that state's gross state product, or GSP.

Consider a simple example. Suppose a farmer pays $300 to purchase seed and fuel and brings in a crop which sells for $1,000. The farm labor, land and capital have added $700 to the value of the purchased seed and fuel, so the value added equals $700. For this analysis of change in value added in the Kansas economy we calculate change in total farm revenues and change in total farm produced input purchases. The difference between these two indicates the on-farm direct change in value added, i.e., the initial change in Kansas GSP. This analysis computes the loss in Kansas GSP as a result of Nebraska's failure to restrict its consumptive use of water.

Secondary Direct and Indirect Impacts

In our example, production and sale of $1,000 in crops resulted in $700 in value added. There are additional effects associated with the $300 spent on produced inputs (in our example, seed and fuel). Suppose one-third of these, or $100, come from sources outside Kansas. With these there are no further effects on Kansas income. The effects associated with the purchase of imported inputs occur in the states hosting their production.

Things are different for the inputs purchased in-state, two-thirds of $300, or $200, in this example. As with production generally, some portion is claimed as the incomes of primary factors, i.e., as value added, while the remainder goes to purchase inputs, in our example, the inputs needed to produce $200 in in-state purchased seed and fuel. Value added in the direct suppliers of agriculture constitutes a secondary impact of agriculture, in this case the *direct* secondary impact, sometimes termed the direct supply chain effect of agriculture.

The in-state suppliers to agriculture not only create value added in their own industries (the "direct effect"), but also purchase supplies of their own, creating value added in the "suppliers of the suppliers." But then there are still further rounds of input purchases, from the "suppliers of the suppliers of the suppliers," and this indirectly creates additional increments of value added. The sum of all these additional effects is termed the *indirect* secondary impact of agriculture.

For simplicity, in summary effects tables below we sum the secondary direct and indirect impacts. So we have the "On-Farm Direct" value added, attributable to the contributions of on-farm primary factors of production, and secondary direct and indirect impacts, attributable to the contributions of primary factors in the various industries that directly or indirectly supply agriculture with produced inputs.

Secondary Consumer Spending-Induced Impacts

Farm production, or change in production, affects value added in the state economy as just described. But the overall effect on value added does not end here. A portion of the value added on farms and in farm-supplying industries appears as personal income to property owners and labor. Making allowance for taxes, savings and general leakages from the economy, the change in personal income results in a change in consumer spending, and this induces still another round of secondary, off-farm value added effects. We label this final effect on value added the "secondary consumer-spending induced effect."

Constructing a Secondary Effects Model

An IMPLAN Regional Input-Output Model for Kansas

Secondary impacts are calculated using models based on economic multipliers, and so secondary impacts will also be commonly referred to as "multiplier impacts," or "multiplier effects."

Secondary impacts (i.e., supply chain direct and indirect effects, plus consumer-spending induced effects) to the Kansas economy were calculated using an input-output form of analysis that is recognized as one of the most widely applied methods in economics (see: Baumol, William, 2000. "Leontief's Great Leap Forward," *Economic Systems Research*, 12, 141-152.). National-level input-output models are now maintained by virtually all industrial countries, including the United States, where input-output analysis was first developed in the 1920s. In 1973, input-output pioneer Wassily Leontief received the Nobel Prize in Economics:

> "...for the development of the input-output method and for its application to important economic problems" (nobelprize.org).

For our analysis we used the IMPLAN regional input-output modeling system. IMPLAN was originally developed in the mid-1980s by the U.S. Forest Service and is now maintained by a private firm, MIG, Inc (Formerly Minnesota IMPLAN Group, Inc.). MIG, Inc. produces complex localized databases, conducts IMPLAN training workshops and distributes IMPLAN software to public and private organizations. The IMPLAN website (IMPLAN.com) lists hundreds of clients, including agencies of both the federal and state governments, colleges and universities, private consultants and research firms, and non-profits. IMPLAN models have been featured in hundreds of research studies and professional journal publications. In addition, MIG hosts periodic users' conferences, in recent years co-sponsored with the Mid-Continent Regional Science Association. In 2000, IMPLAN models of the Kansas and Colorado economies served in an analysis of secondary damages in the matter of Kansas v. Colorado (the Arkansas River case) before the Supreme Court of the United States.

The IMPLAN model for Kansas constructed for our analysis is based on data specific to Kansas, and provides multiplier effects, and other assorted economic measures, specifically reflecting the Kansas economy. The data on which MIG, Inc. produces its input-output tables comes largely from federal sources but with some lag in time. A shortening of that lag in 2008 meant that IMPLAN could provide 2006 data where formerly 2005 data would be available. As a result, MIG skipped 2005 altogether, going straight from 2004 data to 2006 data. Accordingly our analysis of multiplier effects in Kansas in both 2005 and 2006 are estimated using a Kansas IMPLAN model for 2006. We are assuming, thereby, that Kansas input-output multipliers exhibited general stability across this one-year time span. The professional input-output modeling literature supports this assumption, suggesting general stability in regional input-output multipliers, especially across a mere one year time span. Moreover, we use detailed industry multipliers only in so far as these produce our aggregate, i.e., all-industry combined, secondary impacts. Again the professional input-output literature would predict little error (for a review of multiplier stability and estimation of aggregate results see: Miller, R.E. and P. Blair. 2009.

Input-Output Analysis: Foundations and Extensions. Second Edition. Cambridge University Press: New York, pages 309 to 311)

Calculating Secondary Impacts Stemming from Changes in Farm Input Spending

This analysis computes the secondary impacts for 2005 and 2006 and for KBID above and below Lovewell, and outside KBID. The following example illustrates the calculation of secondary impacts (i.e. losses) above Lovewell in 2005 based on the direct effects shown in table 44.

The illustration begins with table 45. The far left column labeled "original" simply repeats the total change in produced input spending and on-farm direct value added as reported in the far left column (above Lovewell, 2005) of table 44. These constitute the initial changes in value added and produced input spending. The first step in estimating the secondary (i.e., multiplier) effects of these initial changes is to net off the portion of produced input purchases that comes from out-of-state suppliers. It is also necessary to "bridge" the farm input commodities of table 44, repeated on the far left of table 45, to standard industry categories of the IMPLAN model. The standard IMPLAN industry categories appear on the far-right of table 45.

The second column of table 45 is sub-headed "Mapped." In this column the "Original" column entry for "Irrigation Fuel and Oil" is further subdivided into diesel, electricity and natural gas sources. The detail for this subdivision was obtained from the US Census of Agriculture, Farm and Ranch Irrigation Survey – interpolating between the allocations reported in the 2003 census and the 2008 census.

The third column of numbers in table 45 is sub-headed "Wholesale Trade Margins %." A farmer will normally purchase inputs such as seed, herbicide, fertilizer and such from a farm wholesaler. The purchase price less the cost of commodity sold equals the wholesaler's "mark-up," or "wholesale margin." The column headed "Wholesale Trade Margins %" shows these mark-up percents for the outputs of the IMPLAN industries listed at the far-right. These margins were obtained from the U.S. National Input-Output model for 2006, the most recent fully detailed version of the US model available. The wholesale trade margins used in this analysis are shown in IMPLAN source supporting documents, and the originals can be downloaded from http://bea.gov/industry/zip/2002detail.zip (member file: REV_NAICSUseDetail 4-24-08.txt).

In table 45, the column headed "Wholesale Margin" is the margin percent times the initial purchase price, and thereby equals the net revenue (gross revenue minus cost of goods sold) of the wholesaler. The column headed "Producer Margin" is the purchase price minus the wholesale margin, and thus equals the gross revenue of the producers. Importantly, note that the sum of wholesale margins from the same-named column appears as the producer margin of its own IMPLAN industry, "Wholesale trade." The sum of changes in wholesale margins equals the change in gross revenues of the wholesale trade sector.

Along with multipliers, a standard element of modern regional input-output models is a set of "regional purchase coefficients," or RPCs. An RPC for a given industry shows the portion of overall regional demand for the output of that industry that is obtained from suppliers located in the region. As an example, an RPC of 30% indicates that 70% of the in-state demand for the

particular commodity is obtained from out-of-state sources and 30% from in-state sources. The column headed "Regional Purchase Coefficient" shows RPCs obtained from the Kansas IMPLAN model for the specific industries shown on the far-right column of table 45.

The column headed "In-State Spending" is obtained as the product of RPCs and producer margins. These are the reductions in the revenues of the various Kansas industries as a result of the loss of irrigation water – i.e. the gross input changes from the far left column of table 44. The next step is to feed these into the Kansas IMPLAN model and thereby calculate secondary effects.

Using IMPLAN Multipliers to Calculate Secondary Value Added Effects

Table 46 repeats the IMPLAN industries shown on the far-right column of table 45, and it repeats the in-state spending shown in table 45. The three columns to the immediate right of these show "IMPLAN Value Added Multipliers." These multipliers are industry-specific, and they are specifically defined for the Kansas economy. They reflect, in particular, Kansas' unique industry mix, its export and import structure, wages, levels of output, and other factors that determine multiplier size.

The multipliers labeled "Secondary Direct" are coefficients showing the value added portion of total industry sales. Multiplying in-state purchases by value added coefficients provides the direct secondary change in value added. The multipliers labeled "Secondary Indirect" are derived from the input-output multiplier matrix. These show the sum of all the additional rounds of value added effects, beyond the direct round, the value added by the "suppliers of the suppliers," as described earlier. Finally, the multipliers labeled "Secondary Induced" are derived from the input-output multiplier matrix, and show the sum of all the value added effects induced by the spending of income on consumer goods.

The final set of table 46 columns show the overall change in Kansas value added as a result of irrigation water shortage. The "On-Farm Direct" column shows the change in value added on farm income account, i.e., the $632,505 figure shown as change in value added in table 44 for 2005 above Lovewell. Figures in the other columns are computed as the product of change in in-state spending and the appropriate value added multipliers. These then constitute the direct and indirect secondary effects, and consumer-spending induced secondary effect on Kansas value added of water shortages.

As noted, the calculations outlined above refer to the secondary impacts of water shortage above Lovewell in 2005. Similar calculations for the other regions and for 2006 are shown in other working tables available in the spreadsheet version of tables 45 and 46.

Summary of Secondary Effects

Table 47 summarizes the effect of irrigation water shortages on Kansas value added. The table shows 2005 and 2006 losses for KBID, both above and below Lovewell, and outside KBID. These are losses in "nominal" dollars – dollars as of the year when the damages occurred.

The "On-Farm Direct" row of table 47 indicates the loss of value added on-farm taken directly from table 44 (also shown as the (On-Farm Direct) column of table 46). As described earlier, this value is computed as the difference between the change in gross farm receipts and the change in farms' produced input purchases. For the 2005 above Lovewell example, the "On-Farm Direct" loss is $633 thousand.

The "Secondary Direct and Indirect" row of table 47 shows the loss of value added stemming from the action of direct and indirect multiplier effects within the Kansas economy. Value added declines in the Kansas industries that supply affected farmers, and in the chain of industries that supply the suppliers. For 2005 above Lovewell, table 46 shows "Secondary Direct" impacts of $292 thousand and "Secondary Indirect" impacts of $122 thousand – which total to the $413 thousand "Secondary Direct and Indirect" losses shown in table 47.

Finally, the "Secondary Induced" column of table 46 shows $288 thousand as the value added loss in consumer-serving industries and in industries that supply the consumer-serving industries. The "Secondary Consumer Spending-Induced" row of table 47 shows the same $288 thousand as the "Secondary Induced" column of table 46. The other columns of table 47 contain value added numbers computed in the other working tables available in the spreadsheet version of tables 45 and 46.

Some analyses of secondary impacts adjust the total to account for the reemployment of production inputs in alternative uses through time. This issue was addressed by Dr. Ray Supalla (Professor Emeritus of Agricultural Economics at the University of Nebraska) in his analysis of irrigation consumptive use reduction in the Platte and Republican Basins (Supalla, et al., Economic and State Budget Cost of Reducing Consumptive Use of Irrigation Water in the Platte and Republican Basins, prepared for the Nebraska Department of Natural Resources, August, 21, 2006). Professor Supalla's explanation of secondary impacts is as follows:

> "The off-farm costs, also called secondary costs in the economics literature are transitory because most of the resources involved eventually find alternative employment. This is why the principles and guidelines used by federal agencies for evaluating water projects do not allow project applicants to count secondary benefits or costs (US Water Resource Council, 1983). The federal agencies assume that the labor and other resources which become unemployed as a result of some change in irrigation (which is called a secondary effect) will eventually move on to alternative employment and earn as much or more than they earned before the change in irrigation. Statewide off-farm costs are indeed zero if the resources which are displaced when irrigation is reduced could immediately find comparably productive alternative employment within Nebraska. But unfortunately some resources are immobile, and in all cases it may take some time before alternative employment can be secured. In addition, some of the resources involved may shift to uses outside the community or to another state. When this happens there is a long-term economic cost at the community and/or state level."
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> :
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> :
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> "Most economists contend that secondary benefits and costs should be ignored in economic analyses because they are both transitory and difficult to estimate.... We

> disagree. In an agricultural state such as Nebraska there is likely to be some lasting effect, if only because some of the people and resources involved may need to leave the state to find alternative employment. In this analysis we assume that off-farm costs at the state level decrease linearly during the first 10 years from 100 percent of the multiplier effects described above in year one to 15 percent in year 10, and then remain at 15 percent for the indefinite future." (Supalla, et al., 2006, pages 8 and 9)

In the Arkansas River case (Kansas v Colorado), only 20 % of secondary impacts was counted as damages. In that case, the damages were long term – the Kansas Arkansas River Basin had been deprived of the water to which it was entitled for many years, so there was ample time for inputs to have been reemployed elsewhere. The 20 percent figure used in the Arkansas River case agreed approximately with Supalla's 100 percent in year one, declining to 15 percent in year 10, and 15 percent thereafter.

In the present case, the water shortage in Kansas was year by year, not permanent. Kansas farmers could hope that next year would be better. They were not likely to move major amounts of resources out of farming to reemployment elsewhere. This analysis follows the implications of Professor Supalla's conclusion -- that 100 percent of secondary impacts in the first year of shortage, 2005 and 2006, count as damages.

Table 47 indicates that in 2005, Kansas GSP was roughly $2.54 million smaller than it would have been if Nebraska had met the requirements of the Decree. In 2006, the figure was some $2.60 million smaller.

INDUCED EFFECTS IN KANSAS OF A NEBRASKA PAYMENT TO KANSAS

If Nebraska is ordered to compensate Kansas for the losses Kansas suffered from Nebraska's overuse of Republican River water, this will cause secondary consumer spending-induced value added effects in Kansas. Thus, the amount Nebraska should pay Kansas to make Kansas whole is an amount equal to the on-farm direct plus the secondary direct and indirect portion of losses (shown on the "Subtotal" row of Table 47), but not the additional secondary consumer spending-induced losses (shown on the "Secondary Consumer Spending-Induced" row of Table 47). Payment of the on-farm direct plus the secondary direct and indirect losses will create secondary consumer-induced effects of its own and the best measure of these would be the secondary consumer-spending induced impacts shown in table 47, thus leaving Kansas whole.

TIME VALUE OF MONEY

A fundamental principle of economics is that past events have a present value which is calculable through an appropriate rate of compounding representing the time value of money. Likewise a future event has a present value, calculable with an appropriate discount rate. That is, a dollar that should have been received in the past is not the same as a dollar in hand today and different yet from the value of a dollar receivable in the future. The past dollar could have been put to productive use through time, making it worth more than the dollar today. The dollar in

hand can be put to productive use through time, making us value it more than a dollar receivable in the future. The productive usefulness of a dollar at any point in time is either to pay off debts or invest in productive enterprises. Thus the measure of the usefulness of a dollar is the greater of cost paid for borrowed capital or returns to reinvested capital. All money exchanges in current dollars for past or future events can, as a fundamental principle of economics or finance, be adjusted for time with an appropriate discount or compounding rate. As a matter of economic principle, compounding a past value to a current (2012) value is a neutral process that does not result in either a windfall for the payee or a penalty for the payor.

In this case, it is necessary to compound historic Kansas damages to a 2012 value to have a just settlement of such damages in the present. Another corollary of the current value rule is that delay for any reason in paying compensation for past losses is properly accounted for by appropriate compounding.

Interest rates for compounding past events to a current value must be chosen to represent the appropriate time value of money for the parties involved. For example, in money lending, the chosen interest rate will depend upon such factors as the length of the loan, the credit rating of the borrower, the amount of collateral for loan security, tax rules for interest payments received and paid, and the anticipated rate of inflation. The cost of borrowed capital is one possible measure for the opportunity cost (best alternative use) of capital. The other is the return to invested capital. Since efficient use of borrowed capital requires that returns to capital investment exceed the cost of borrowing, an entrepreneur using borrowed capital for business operations or investment must, in theory, gain more from the use of that capital than it cost in order to maintain a profitable business. In any case, the opportunity cost of capital will be the higher value of either the cost of borrowing or the rate-of-return to invested capital or a combination of these two costs if marginal funds are potentially applied to both uses.

When estimating the present value of past events, it is common that the interest rates for compounding will vary through time. This occurs because the above described factors affecting interest rates will also be changing. For example, in determining the present value of past Kansas damages it is necessary to choose nominal interest rates that are appropriate for the varying conditions from 2005 to the present.

Nominal interest rates are expressed in current values and contain a premium for anticipated inflation. Differences in nominal interest rates at any point in time reflect the effects of two basic phenomena, risk and taxes. The effect of risk on interest rates is to increase their level. Risk to the lender is influenced by the security of the loan, the credit worthiness of the borrower, and the length of the borrowing period. As the probability that a lender will be unable to collect all capital and interest payments due in a timely manner increases, the greater is the risk of loss and the higher must be the interest rate to account for this risk. In general, a loan secured by real property (home or land) will incur a lower interest rate than an unsecured loan. Credit card borrowers are at a much greater risk of loan default than, say, home buyers and therefore incur a much higher interest rate for borrowed capital.

Farmers in the study area are likely to encounter more than one nominal interest rate in their conduct of business due to the length of the loan period and the level of security of the loan. The

interest rate on an unsecured loan for annual operating expenses will contain a premium for risk of loan default, whereas, secured loans for investments in land will likely face a lower interest rate than that for annual operating capital. It is common for each farm to obtain and use both short-term and long-term capital in both secured and unsecured form, thereby facing more than one level of interest cost for farm operations.

The "cost of capital" for a business to use as the discount rate in capital budgeting is generally considered to be the weighted average after-tax costs of debt and equity capital, using the respective ratios of debt and equity to total assets as the weights The expected returns to equity capital, including both current returns and capital gains, normally must exceed the average cost of debt by a sufficient margin to account for the borrower's greater risk in managing equity capital. This condition must hold in the long run in order for it to be feasible and profitable to borrow capital for business operations. This principle applies equally to a farm business.

Unfortunately for this study, it was not possible to find reliable measures of the returns to equity for farms in the study region for the period of analysis. As a conservative measure of interest rates for compounding past damages to a current value, the cost of debt capital is used to represent both the cost of debt and the returns to equity capital. Since the returns to equity capital must exceed the cost of debt for long term profitability, using debt costs alone will understate the true cost of capital and, thus, reflect a conservative valuation approach.

A conservative and readily available measure of the cost of debt which also takes into account the effect of taxes is the interest rate on high grade tax free municipal bonds. Recent interest rates for high grade municipals are published by the Council of Economic Advisors. Rates for the relevant time period are shown in table 48. Interest rates only through October 8th were available at the time this report was compiled. Table 48 implicitly assumes that the 2011 average rate of 4.372 percent will persist through January 1, 2012. Since these rates are published weekly, near-current rates can be obtained to update present values to whatever date is needed for this case.

Choosing the interest rate on high grade tax free municipal bonds as the compounding factor in this analysis is a conservative choice for several reasons. Interest rates on other forms of debt are generally higher, because these other forms of debt have higher risk. Also the returns on equity capital will be higher than the interest rate on debt if the enterprise is profitable.

Using the interest rate for high grade tax free municipal bonds, table 48 shows that the 2005 direct and secondary damages calculated above would be multiplied by 1.300 to get a present value in dollars valued as of January 1, 2012. The 2006 direct and secondary damages calculated above would be multiplied by 1.245 to get a January 1, 2012 present value.

TOTAL KANSAS LOSSES

Table 49 reports the same summary loss values as table 47 but compounded forward to January 1, 2012 dollars, using the compounding factors from table 48. Since all the dollar figures now represent a common year it is possible to sum them together into an aggregate Kansas loss value for both years.

Table 49 shows the final result, $6,577,165 in January 1, 2012 dollars, as the loss to the Kansas economy resulting from Nebraska's overuse of Republican River water in 2005 and 2006, in excess of what is required by the Decree. The table also shows $5,126,992 as the necessary payment by Nebraska to erase Kansas' GSP loss (i.e., its loss of value added) As noted above, a payment equal to the on-farm direct plus the secondary direct and indirect losses (the $5.1 million) will induce its own secondary consumer-spending impacts, making up the other $1.5 million necessary to make Kansas whole.

SUPPORTING DOCUMENTS

(Underlined portions are folder or file names in the archive of supporting documents)

1. Dale Book, and Angela Schenk "Engineering Analysis of Losses to Kansas Water Users Resulting from Overuse of Republican River Supply in Nebraska 2005 and 2006," Spronk Water Engineers, Inc, November 1011.
2. Norman Klocke, "Development of Crop Production Functions For Irrigation in North Central Kansas," NLK Engineering, November 18, 2011
3. **KBID Annual Reports** folder contains Kansas Bostwick Irrigation District Annual Reports 1991 through 2010.
4. **Kansas Crop Budgets** folder contains Kansas Crop Budgets for 2005 and 2006.
5. **NASS Data** folder contains National Agricultural Statistics Service data on crop acreage and price.
6. **Beaton.pdf** A. Beaton, "Per Unit Costs to Own and Operate Farm Machinery on Kansas Farms", MS Thesis, Kansas State University, 2003.
7. **Economic Indicators.jpg** Office of the President, Council of Economic Advisors, Economic Indicators, September 2011, page 30.
8. **FSA-28 Irrigation Costs.pdf** R. Hogan, S. Stiles, P. Tacker, E. Vories and K. Bryant, "Estimating Irrigation Costs", University of Arkansas, FSA28, 2007.
9. **KBID email of 7 8 2011 -- Crop Acres for 2007 to 2010.txt**
10. **Ross email of 10 10 2011 -- KBID acres by county.txt**
11. **Ross emailed file of 4 4 11 -- Jewell and Republic KS PP Claims.xls**
12. **Secondary Damages.pdf** D. Willis, J. Hamilton, M. Robison, N. Whittlesey, and J. Draper, Secondary Damages in Interstate Water Compact Litigation, Natural Resources Journal, Summer 2008, pages 679 through 696.
13. **Supalla.pdf** R. Supalla, T. Buell and B. McMullen, "Economic and State Budget Cost of Reducing the Consumptive Use of Irrigation Water in the Platte and Republican Basins," prepared for the Nebraska Department of Natural Resources, August 21, 2006.
14. Baumol, William, 2000. "Leontief's Great Leap Forward," *Economic Systems Research*, 12, 141-152.).
15. Miller, R.E. and P. Blair. 2009. *Input-Output Analysis: Foundations and Extensions*. Second Edition. Cambridge University Press: New York.

Kansas Tables and Figures

Table 1: Irrigated Acres in KBID Above Lovewell

Year	Irrigated Acres Corn	Milo	Soybean	Alfalfa	Sunflower	Ensilage	Total
1991[1/]	5,013	0	2,333	0	0	0	7,346
1992[1/]	9,425	0	455	0	0	0	9,880
1993[1/]	9,953	0	1,200	0	0	0	11,153
1994	9,319	0	1,287	0	0	95	10,701
1995	9,273	103	2,648	333	0	0	12,357
1996	11,766	0	1,651	1,515	0	0	14,932
1997	9,321	100	3,861	0	0	0	13,282
1998	10,208	0	2,485	0	0	0	12,693
1999	10,043	22	2,484	137	0	0	12,686
2000	6,898	0	5,386	0	0	0	12,284
2001[1/]	7,012	482	4,119	635	0	0	12,248
2002[1/]	8,693	109	2,472	1,138	0	0	12,412
2003[1/]	5,799	2,701	3,452	1,481	0	0	13,433
2004[1/]	0	0	0	0	0	0	0
2005[1/ 2/]	566	89	318	132	0	3	1,107
2006[1/]	3,028	474	1,704	705	0	14	5,925 [3/]
2007[1/ 4/]	5,083	686	2,138	1,016	0	0	8,923
2008[1/ 4/]	5,070	372	3,545	808	0	0	9,795
2009[1/ 4/]	6,220	225	3,133	769	0	0	10,346
[4/] 2010	5,656	110	3,458	648	0	0	9,872

[1/] Years of short supply, 2001-2009, start season with restrictions.

[2/] 2005 total acreage was reported as zero in the KBID annual report. The 1,107 total acreage came from USBR annual operating plans. This number was provided by SWE in their Kansas Loss report. Total 2005 acreage was allocated to crops in the same percentages as was reported for 2006.

[3/] Incorrectly reported as 5,825 acres in KBID report. The sum of KBID reported crop acres is 5,925, which is also consistent with KBID reported total irrigated acres, and the acreage figure used in the SWE Kansas Loss report..

[4/] 2007 - 2010 acres by crop were provided by Don Lieb, KBID Office Manager (KBID email of 7 8 2011 - - Crop Acres for 2007 to 2010)

Source:KBID annual reports except as noted.

Table 2: Irrigated Acres in KBID Below Lovewell

Year	Irrigated Acres Corn	Milo	Soybean	Alfalfa	Sunflower	Ensilage	Total
1991[1/]	18,073	328	4,466	0	0	344	23,211
1992[1/]	13,398	0	310	0	0	0	13,708
1993[1/]	19,742	0	2,963	0	0	0	22,705
1994	20,093	0	4,032	0	0	0	24,125
1995	19,334	77	6,065	312	330	0	26,118
1996	14,619	459	5,018	146	0	0	20,242
1997	21,334	155	3,551	663	0	0	25,703
1998	17,004	108	7,885	566	0	0	25,563
1999	17,039	0	8,502	540	0	0	26,081
2000	16,312	0	11,276	0	0	0	27,588
2001[1/]	13,622	2,310	10,427	478	0	0	26,837
2002[1/]	16,265	1,077	7,535	2,017	0	0	26,894
2003[1/]	12,089	6,510	3,096	1,188	111	33	23,027
2004[1/]	11,125	1,924	8,801	986	62	136	23,034
2005[1/]	12,568	1,203	7,694	1,686	235	52	23,438
2006[1/]	10,434	310	9,803	2,092	0	14	22,653
2007[1/ 2/]	15,534	649	6,718	1,132	0	0	24,032
2008[1/ 2/]	13,002	370	10,367	1,800	0	0	25,538
2009[1/ 2/]	13,997	18	10,162	1,808	0	0	25,985
[2/] 2010	14,664	345	10,104	1,611	0	0	26,723

[1/] Years of short supply, 2001-2009, start season with restrictions.

[2/] 2007 - 2010 acres by crop were provided by Don Lieb, KBID Office Manager (KBID email of 7 8 2011 -- Crop Acres for 2007 to 2010)

Source: KBID annual reports except as noted.

Table 3: Crop Mix Percent by Year above Lovewell

Year	Corn	Milo	Soybean	Alfalfa	Sunflower	Ensilage
1991[1/]	68.2%	0.0%	31.8%	0.0%	0.0%	0.0%
1992[1/]	95.4%	0.0%	4.6%	0.0%	0.0%	0.0%
1993[1/]	89.2%	0.0%	10.8%	0.0%	0.0%	0.0%
1994	87.1%	0.0%	12.0%	0.0%	0.0%	0.9%
1995	75.0%	0.8%	21.4%	2.7%	0.0%	0.0%
1996	78.8%	0.0%	11.1%	10.1%	0.0%	0.0%
1997	70.2%	0.8%	29.1%	0.0%	0.0%	0.0%
1998	80.4%	0.0%	19.6%	0.0%	0.0%	0.0%
1999	79.2%	0.2%	19.6%	1.1%	0.0%	0.0%
2000	56.2%	0.0%	43.8%	0.0%	0.0%	0.0%
2001[1/]	57.3%	3.9%	33.6%	5.2%	0.0%	0.0%
2002[1/]	70.0%	0.9%	19.9%	9.2%	0.0%	0.0%
2003[1/]	43.2%	20.1%	25.7%	11.0%	0.0%	0.0%
2004[1/]	n/a	n/a	n/a	n/a	n/a	n/a
2005[1/ 2/]	51.1%	8.0%	28.8%	11.9%	0.0%	0.2%
2006[1/]	51.1%	8.0%	28.8%	11.9%	0.0%	0.2%
2007[1/]	57.0%	7.7%	24.0%	11.4%	0.0%	0.0%
2008[1/]	51.8%	3.8%	36.2%	8.2%	0.0%	0.0%
2009[1/]	60.1%	2.2%	30.3%	7.4%	0.0%	0.0%
2010	57.3%	1.1%	35.0%	6.6%	0.0%	0.0%

[1/] Years of short supply, 2001-2009, start season with restrictions.

[2/] 2005 total of 1,107 acres was allocated to crops in the same percentages as was reported for 2006.

Source: Table 1

Table 4: Crop Mix Percent by Year below Lovewell

Year	Corn	Milo	Soybean	Alfalfa	Sunflower	Ensilage
1991[1/]	77.9%	1.4%	19.2%	0.0%	0.0%	1.5%
1992[1/]	97.7%	0.0%	2.3%	0.0%	0.0%	0.0%
1993[1/]	87.0%	0.0%	13.0%	0.0%	0.0%	0.0%
1994	83.3%	0.0%	16.7%	0.0%	0.0%	0.0%
1995	74.0%	0.3%	23.2%	1.2%	1.3%	0.0%
1996	72.2%	2.3%	24.8%	0.7%	0.0%	0.0%
1997	83.0%	0.6%	13.8%	2.6%	0.0%	0.0%
1998	66.5%	0.4%	30.8%	2.2%	0.0%	0.0%
1999	65.3%	0.0%	32.6%	2.1%	0.0%	0.0%
2000	59.1%	0.0%	40.9%	0.0%	0.0%	0.0%
2001[1/]	50.8%	8.6%	38.9%	1.8%	0.0%	0.0%
2002[1/]	60.5%	4.0%	28.0%	7.5%	0.0%	0.0%
2003[1/]	52.5%	28.3%	13.4%	5.2%	0.5%	0.1%
2004[1/]	48.3%	8.4%	38.2%	4.3%	0.3%	0.6%
2005[1/]	53.6%	5.1%	32.8%	7.2%	1.0%	0.2%
2006[1/]	46.1%	1.4%	43.3%	9.2%	0.0%	0.1%
2007[1/]	64.6%	2.7%	28.0%	4.7%	0.0%	0.0%
2008[1/]	50.9%	1.4%	40.6%	7.0%	0.0%	0.0%
2009[1/]	53.9%	0.1%	39.1%	7.0%	0.0%	0.0%
2010	54.9%	1.3%	37.8%	6.0%	0.0%	0.0%

[1/] Years of short supply, 2001-2009, start season with restrictions.
Source: Table 2

Figure 1: Crop Mix Above Lovewell

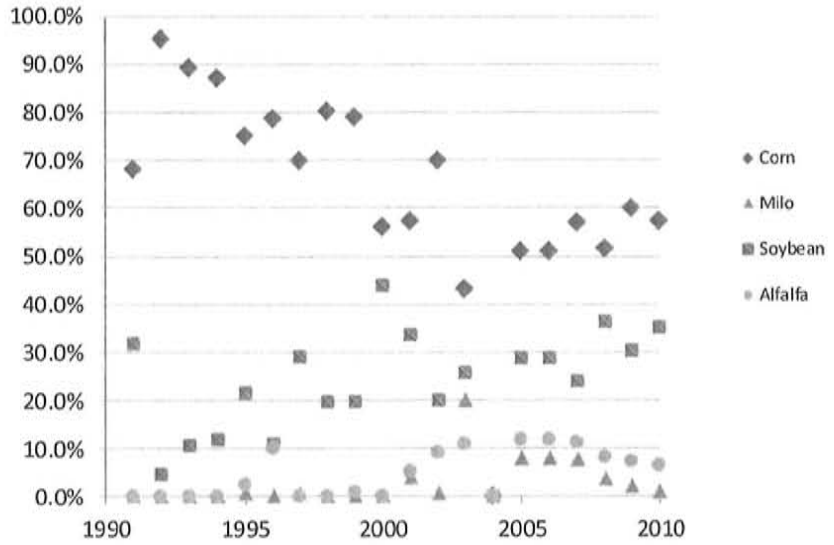

Figure 2: Crop Mix Below Lovewell

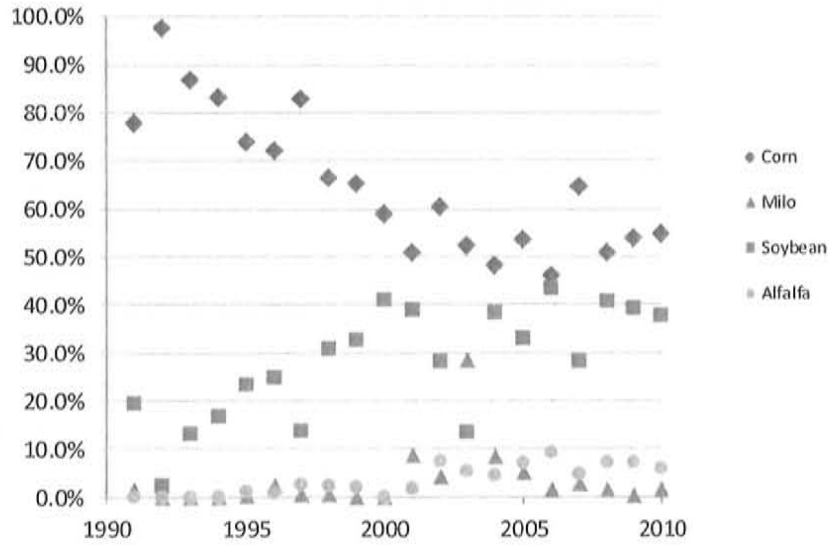

Table 5: Classified and Actual Irrigated Acres in KBID

		Actual Irrigated Acres					
	Classified Acres [1]	Total	Above Lovewell [2]	Below Lovewell [2]	Irrigated as % of Classified	Above Lovewell as % of Irrigated	Below Lovewell as % of Irrigated
1991	42,488	30,881	7,680	23,201	72.7%	24.9%	75.1%
1992	42,458	23,589	9,880	13,709	55.6%	41.9%	58.1%
1993	42,537	33,858	11,153	22,705	79.6%	32.9%	67.1%
1994	42,523	34,933	10,792	24,141	82.2%	30.9%	69.1%
1995	42,523	38,485	12,357	26,128	90.5%	32.1%	67.9%
1996	42,574	35,431	15,188	20,243	83.2%	42.9%	57.1%
1997	42,574	38,985	13,282	25,703	91.6%	34.1%	65.9%
1998	42,574	38,485	12,702	25,784	90.4%	33.0%	67.0%
1999	42,650	38,788	12,708	26,080	90.9%	32.8%	67.2%
2000	42,863	40,711	12,691	28,067	95.0%	31.1%	68.9%
2001	42,805	39,173	12,248	26,925	91.5%	31.3%	68.7%
2002	42,922	39,499	12,458	26,991	92.0%	31.6%	68.4%
2003	43,021	36,460	13,433	23,027	84.7%	36.8%	63.2%
2004	43,114	23,035	0	23,035	53.4%	0.0%	100.0%
2005	43,100	24,546	1,107 [3]	23,439	57.0%	4.5%	95.5%
2006	43,048	28,580	5,925 [4]	22,654	66.4%	20.7%	79.3%
2007	43,018	32,979	8,923	24,032	76.7%	27.1%	72.9%
2008	43,045	35,356	9,795	25,538	82.1%	27.7%	72.3%
2009	43,018	36,362	10,346	25,985	84.5%	28.5%	71.5%
2010	43,055	36,758	9,872	26,723	85.4%	27.0%	73.0%
Average 1994-2000	42,612	37,974	12,817	25,164	89.1%	33.7%	66.3%

[1] Classified acres are certified by KBID as eligible to receive irrigation water.
[2] These acres differ slightly from the numbers in tables 1 and 2 because those acres were based on the KBID crop census, and the numbers in this table are the reported irrigated acres from the KBID annual reports based on their irrigation operating data.
[3] 2005 total acreage was reported as zero in the KBID annual report. The 1,107 total acreage came from USBR annual operating plans. This number was provided by SWE in their Kansas Loss report.
[4] Incorrectly reported as 5,825 acres in KBID report. The sum of KBID reported crop acres is 5,925, which is also consistent with KBID reported total irrigated acres, and the acreage figure used in the SWE Kansas Loss report.
Source: KBID Annual Reports except as noted

Table 6: Acres that Would Have been Irrigated With Required Water Supply

	Classified	% Irrigated	% Above	% Below	Acres Above Lovewell	Acres Below Lovewell
2005	43,100	89.1%	33.7%	66.3%	12,962	25,448
2006	43,048	89.1%	33.7%	66.3%	12,946	25,417

Source: Table 5

Table 7: Crops that Would Have been Irrigated With Required Water Supply

2005 Above Lovewell	Corn	Milo	Soybeans	Alfalfa	Sunflower	Silage	Total
2010 Crop Mix	57.3%	1.1%	35.0%	6.6%	0.0%	0.0%	100.0%
Acres	7,426	144	4,540	851	0	0	12,962
Below Lovewell							
2010 Crop Mix	54.9%	1.3%	37.8%	6.0%	0.0%	0.0%	100.0%
Acres	13,964	329	9,621	1,534	0	0	25,448
2006 Above Lovewell	Corn	Milo	Soybeans	Alfalfa	Sunflower	Silage	Irrigated
2010 Crop Mix	57.3%	1.1%	35.0%	6.6%	0.0%	0.0%	100.0%
Acres	7,417	144	4,535	850	0	0	12,946
Below Lovewell							
2010 Crop Mix	54.9%	1.3%	37.8%	6.0%	0.0%	0.0%	100.0%
Acres	13,947	328	9,610	1,532	0	0	25,417

Sources: Tables 5 and 6

Table 8: Prevented Planting Data

Reported Numbers	2005 Jewell	Republic	2006 Jewell	Republic	Total 2,005	2,006	Both Counties 2005 & 06
Acres of Prevented Planting	988	1,347	683	1,167	2,335	1,851	4,186
Indemnity Payments	$180,377	$240,085	$182,331	$262,159	$420,462	$444,490	$868,869 [1/]
Payment per Acre	$182.64	$178.18	$266.80	$224.55	$180.07	$240.15	
Premium Payments							$153,876 [1/]
Premiums as % of Indemnity							17.7%
	2005		2006				
For Analysis:	Above Lovewell	Below Lovewell	Above Lovewell	Below Lovewell			
Acres in Dryland Alternatives	11,855	2,009	7,021	2,763			
PP Acres Used in analysis	1,997	338	1,328	523			

[1/] From document RMA foia 11106b -- Prevented Planting from RMA production request, "2005 and 2006 Prevented Planting in the Republican River Basin (KS and NE)", 9/15/2011
Source: Ross emailed file of 4/4/11 -- Jewell and Republic KS PP Claims, except as noted.

Table 9: Kansas Dryland Acres Planted, from NASS

	2005 County	Corn	Milo	Soybeans	Alfalfa	Sunflower	Wheat	Total	Acres KBID in County [1/]	% KBID in County [1/]
Acres:	Jewell	9,600	58,800	26,800	13,500	7,300	134,200	250,200	8,494	19.7%
	Republic	34,500	34,000	42,500	10,700	4,400	101,200	227,300	34,561	80.3%
Crop Mix:	Jewell	8.3%	50.7%	23.1%	11.6%	6.3%				
	Republic	27.4%	27.0%	33.7%	8.5%	3.5%				
Wtd Crop Mix w/o Wheat		23.6%	31.6%	31.6%	9.1%	4.0%		100.0%		
	2006 County	Corn	Milo	Soybeans	Alfalfa	Sunflower	Wheat	Total		
Acres:	Jewell	8,200	51,900	39,100	14,300	3,000	135,900	252,400	8,494	19.7%
	Republic	29,700	27,300	54,900	16,500	1,700	98,500	228,600	34,561	80.3%
Crop Mix:	Jewell	7.0%	44.5%	33.6%	12.3%	2.6%				
	Republic	22.8%	21.0%	42.2%	12.7%	1.3%				
Wtd Crop Mix w/o Wheat		19.7%	25.6%	40.5%	12.6%	1.6%		100.0%		

[1/] KBID acres by county from Kenny Nelson (Ross email of 10 10 2011 -- KBID acres by county)
Source: National Agricultural Statistical Service except as noted

Table 10: Effect of Water Shortage on Dryland Crop Acres

2005 Above Lovewell	Total Acres	Corn	Milo	Soybeans	Alfalfa	Sunflower	Wheat
Acres with Required Water	12,962						
Less Actually Irrigated	1,107						
Dryland Alternatives	11,855						
Less Prevented Planting	1,997						
Jewell & Republic Crop Mix		23.6%	31.6%	31.6%	9.1%	4.0%	0.0%
Dryland Crops	9,858	2,326	3,119	3,116	898	399	0
Below Lovewell							
Acres with Required Water	25,448						
Less Actually Irrigated	23,439						
Dryland Alternatives	2,009						
Less Prevented Planting	338						
Dryland Crops	1,670	394	529	528	152	68	0
2006 Above Lovewell							
Acres with Required Water	12,946						
Less Actually Irrigated	5,925						
Dryland Alternatives	7,021						
Less Prev. Planting	1,328						
Jewell & Republic Crop Mix		19.7%	25.6%	40.5%	12.6%	1.6%	0.0%
Dryland Crops	5,693	1,122	1,459	2,305	717	89	0
Below Lovewell							
Acres with Required Water	25,417						
Less Actually Irrigated	22,654						
Dryland Alternatives	2,763						
Less Prev. Planting	523						
Dryland Crops	2,240	442	574	907	282	35	0

Sources: Tables 5, 6, 8 and 9

Table 11: Acreage Scenarios With Actual and With Required Water Supply

	2005						2006					
	Above Lovewell		Below Lovewell		All KBID		Above Lovewell		Below Lovewell		All KBID	
Irrigated	Actual Water	Required Water	Actual Water	Required Water	Actual Water	Required Water	Actual Water	Required Water	Actual Water	Required Water	Actual Water	Required Water
Corn (& Silage)	568	7,426	12,620	13,964	13,188	21,390	3,042	7,417	10,448	13,947	13,490	21,365
Milo (& Sunflower)	89	144	1,438	329	1,527	472	474	144	310	328	784	472
Soybeans	318	4,540	7,694	9,621	8,012	14,161	1,704	4,535	9,803	9,610	11,507	14,144
Alfalfa	132	851	1,686	1,534	1,818	2,385	705	850	2,092	1,532	2,797	2,382
Total	1,107	12,962	23,438	25,448	24,545	38,409	5,925	12,946	22,653	25,417	28,578	38,363
Dryland Crops												
Prevented Planting	1,997		338		2,335		1,328		523		1,851	
Corn (& Silage)	2,326		394		2,720		1,122		442		1,564	
Milo (& Sunflower)	3,518		596		4,114		1,548		609		2,157	
Soybeans	3,116		528		3,644		2,305		907		3,212	
Alfalfa	898		152		1,050		717		282		1,000	
Total	11,855		2,009		13,863		7,021		2,763		9,784	

Sources: Tables 1, 7 and 10

Table 12: Irrigation Application Rates, Actual and with Required Water Supply

	2005		2006	
Water Application in inches	Above Lovewell	Below Lovewell	Above Lovewell	Below Lovewell
Dryland	0.00	0.00	0.00	0.00
Rates with Actual Water	6.1	6.2	6.8	7.7
Rates with Required Water	10.5	10.5	11.3	11.3

Source: SWE Kansas Losses report, table 3

Table 13: Yield Model Parameters

Crop	System	NIR	Et_{inc}	Y_n/Y_f	Y_f	b	Y_n	AE (%)	β
		inches	inches		bu/acre	bu/ac-in	bu/acre	%	
Corn	Center Pivot	10.1	7.5	0.54	182	11.2	98	85	0.63
Corn	Furrow	10.1	7.5	0.54	182	11.2	98	60	0.45
Soybean	Center Pivot	8.6	5.7	0.68	63	3.5	43	85	0.56
Soybean	Furrow	8.6	5.7	0.68	63	3.5	43	60	0.40
Sorghum	Center Pivot	7.4 [1]	5	0.76	134 [2]	6.4	102 [2]	85	0.57
Sorghum	Furrow	7.4 [1]	5	0.76	134 [2]	6.4	102 [2]	60	0.41
		inches	inches		bu/acre	bu/ac-in	bu/acre	%	
Alfalfa	Center Pivot	16 [1]	12	0.6	6.5 [3]	0.2	3.9 [4]	85	0.64

Sources: Source: Table 1 from expert report by Norm Klocke

[1] From USDA Natural Resources Conservation Service Kansas Irrigation Guide.

[2] From Kansas State University Performance Test Data & National Agricultural Statistical Service (NASS).

[3] From consultation with Scott Staggenborg, Kansas State University Agronomist

[4] From NASS

Table 14: Calculated KBID Crop Yields Using Yield Model

Yields for Dryland Crops		2005 Above Lovewell	2005 Below Lovewell	2006 Above Lovewell	2006 Below Lovewell
Corn (& Silage)	bushels/acre	98.0	98.0	98.0	98.0
Milo (& Sunflower)	bushels/acre	102.0	102.0	102.0	102.0
Soybeans	bushels/acre	43.0	43.0	43.0	43.0
Alfalfa	tons/acre	3.9	3.9	3.9	3.9
Crop Yields with Actual Water Rates					
Pivot		**Above Lovewell**	**Below Lovewell**	**Above Lovewell**	**Below Lovewell**
Corn (& Silage)	bushels/acre	155.2	156.0	160.2	166.0
Milo (& Sunflower)	bushels/acre	130.1	130.4	131.8	133.3
Soybeans	bushels/acre	59.1	59.3	60.2	61.4
Alfalfa	tons/acre	5.0	5.0	5.1	5.2
Furrow		**Above Lovewell**	**Below Lovewell**	**Above Lovewell**	**Below Lovewell**
Corn (& Silage)	bushels/acre	151.1	151.7	155.4	160.4
Milo (& Sunflower)	bushels/acre	127.9	128.2	129.5	131.1
Soybeans	bushels/acre	58.0	58.1	59.0	60.0
Crop Yields with Required Water Rates		**2005**		**2006**	
Pivot		**Above Lovewell**	**Below Lovewell**	**Above Lovewell**	**Below Lovewell**
Corn (& Silage)	bushels/acre	179.2	179.2	181.3	181.3
Milo (& Sunflower)	bushels/acre	134.0	134.0	134.0	134.0
Soybean	bushels/acre	63.0	63.0	63.0	63.0
Alfalfa	tons/acre	5.6	5.6	5.7	5.7
Furrow		**Above Lovewell**	**Below Lovewell**	**Above Lovewell**	**Below Lovewell**
Corn (& Silage)	bushels/acre	172.4	172.4	174.9	174.9
Milo (& Sunflower)	bushels/acre	133.7	133.7	133.9	133.9
Soybean	bushels/acre	62.2	62.2	62.5	62.5

Sources: Tables 12 and 13

Table 15: Yield Inputs for Crop Budgets

	2005					2006				
	Pivot		Furrow			Pivot		Furrow		
Above Lovewell	Required Water	Actual Water	Required Water	Actual Water	Dry	Required Water	Actual Water	Required Water	Actual Water	Dry
Irrigation (in)	10.5	6.1	10.5	6.1	0.0	11.3	6.8	11.3	6.8	0.0
Yields:										
Corn (bu)	179.2	155.2	172.4	151.1	98.0	181.3	160.2	174.9	155.4	98.0
Milo (bu)	134.0	130.1	133.7	127.9	102.0	134.0	131.8	133.9	129.5	102.0
Soybeans (bu)	63.0	59.1	62.2	58.0	43.0	63.0	60.2	62.5	59.0	43.0
Alfalfa (tons)	5.6	5.0			3.9	5.7	5.1			3.9
Below Lovewell										
Irrigation (in)	10.5	6.2	10.5	6.2	0.0	11.3	7.7	11.3	7.7	0.0
Yields:										
Corn (bu)	179.2	156.0	172.4	151.7	98.0	181.3	166.0	174.9	160.4	98.0
Milo (bu)	134.0	130.4	133.7	128.2	102.0	134.0	133.3	133.9	131.1	102.0
Soybeans (bu)	63.0	59.3	62.2	58.1	43.0	63.0	61.4	62.5	60.0	43.0
Alfalfa (tons)	5.6	5.0			3.9	5.7	5.2			3.9

Sources: Tables 10 and 14

Table 16: Crop Prices Used in Analysis

	Corn	Milo	Soybeans	Alfalfa
	$/bu	$/bu	$/bu	$/ton
2005	2.07	1.70	5.45	75.00
2006	3.08	3.37	6.37	113.00

Source: National Agricultural Statistical Service

Table 17: Machinery Cost Breakdown

Category	2005	2006
Fuel	11.8%	11.8%
Repairs	18.5%	18.5%

Source: Adapted from Aaron Beaton, "Per Unit Costs to Own and Operate Farm Machinery on Kansas Farms", MS Thesis, Kansas State University, 2003.

Table 18: Sprinkler and Furrow Irrigation in 2010

Ditch Ride	Acres Pivot	Acres Drip	Total Pivot & Drip	Acres Ditch	Acres Gated Pipe	Total Pipe & Ditch	Percent Pivot	Percent Furrow
Above Lovewell								
1	282.2	0.0	282.2	0.0	1,025.6	1,025.6		
2	2,982.0	0.0	2,982.0	18.1	2,553.6	2,571.7		
3	3,206.0	0.0	3,206.0	484.8	2,016.7	2,501.5		
4	245.3	0.0	245.3	68.4	531.7	600.1		
	6,715.5	0.0	6,715.5	571.3	6,127.6	6,698.9	50.1%	49.9%
Below Lovewell								
5	808.9	0.0	808.9	56.5	607.0	663.5		
6	2,098.3	0.0	2,098.3	1,200.0	2,516.1	3,716.1		
7	2,601.2	80.5	2,681.7	84.0	2,290.3	2,374.3		
8	2,021.4	0.0	2,021.4	115.8	2,700.7	2,816.5		
9	3,194.6	0.0	3,194.6	101.5	1,370.0	1,471.5		
10	2,537.0	0.0	2,537.0	396.5	2,210.7	2,607.2		
11	1,408.8	0.0	1,408.8	173.8	2,239.3	2,413.1		
	14,670.2	80.5	14,750.7	2,128.1	13,934.1	16,062.2	47.9%	52.1%

Source: 2010 KBID Annual Report

Table 19: Kansas Corn Crop Budgets Above Lovewell

	2005							2006						
	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-2601	MF-2601 Required	MF-2601 Actual	MF-2601 Required	MF-2601 Actual	MF-2161	MF-2161	MF-2601	MF-2601 Required	MF-2601 Actual	MF-2601 Required	MF-2601 Actual	MF-2161	MF-2161
Inches Water Applied	16	10.5	6.1	10.5	6.1	0	0	16	11.3	6.8	11.3	6.8	0	0
INCOME PER ACRE														
Yield per acre	175.0	179.2	155.2	172.4	151.1	104.0	98.0	175.0	181.3	160.2	174.9	155.4	104.0	98.0
Price per bushel	2.32	2.07	2.07	2.07	2.07	2.32	2.07	2.71	3.08	3.08	3.08	3.08	2.71	3.08
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	406.00	371.02	321.31	356.93	312.77	241.28	202.86	474.25	558.40	493.36	538.73	478.63	281.84	301.84
SPENDING ON PRODUCED INPUTS														
Seed	54.00	54.00	54.00	54.00	54.00	43.20	43.20	57.30	57.30	57.30	57.30	57.30	45.84	45.84
Herbicide	29.66	29.66	29.66	29.66	29.66	29.66	29.66	30.80	30.80	30.80	30.80	30.80	30.80	30.80
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	77.50	79.45	68.38	76.31	66.47	44.40	41.66	73.11	75.83	66.71	73.07	64.64	42.11	39.54
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	22.75	23.30	20.18	22.42	19.64	13.52	12.74	22.75	23.57	20.82	22.74	20.20	13.52	12.74
Machinery Fuel and Oil	n/a	10.84	10.04	10.61	9.90	n/a	8.18	n/a	11.38	10.66	11.17	10.50	n/a	8.58
Machinery Repairs and Maintenance	n/a	16.99	15.74	16.64	15.53	n/a	12.83	n/a	17.85	16.72	17.51	16.46	n/a	13.46
Irrigation Fuel and Oil	48.00	22.34	12.98	19.55	10.68	0.00	0.00	36.00	18.03	10.85	15.78	8.93	0.00	0.00
Irrigation Repairs and Maintenance	5.28	2.26	1.31	0.78	0.45	0.00	0.00	5.28	2.43	1.46	0.84	0.51	0.00	0.00
Water District Assessment	0.00	21.63	10.00	21.63	10.00	0.00	10.00	0.00	21.63	10.00	21.63	10.00	0.00	10.00
Spending on Produced Inputs $/acre		260.47	222.29	251.60	216.34		158.27		258.83	225.33	250.83	219.34		160.96
Value Added $/acre		110.55	99.02	105.33	96.43		44.59		299.57	268.03	287.89	259.29		140.88

Sources: KSU crop budgets and tables 15 through 18

Table 20: Kansas Milo Crop Budgets Above Lovewell

	2005							2006						
	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-2600	MF-2600 Required	MF-2600 Actual	MF-2600 Required	MF-2600 Actual	MF-2159	MF-2159	MF-2600	MF-2600 Required	MF-2600 Actual	MF-2600 Required	MF-2600 Actual	MF-2159	MF-2159
Inches Water Applied	14	10.5	6.1	10.5	6.1	0	0	14	11.3	6.8	11.3	6.8	0	0
INCOME PER ACRE														
Yield per acre	105.0	134.0	130.1	133.7	127.9	97.0	102.0	105.0	134.0	131.8	133.9	129.5	97.0	102.0
Price per bushel	2.25	1.70	1.70	1.70	1.70	2.25	1.70	2.63	3.37	3.37	3.37	3.37	2.63	3.37
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	236.25	227.80	221.25	227.28	217.50	218.25	173.40	276.15	451.58	444.07	451.33	436.31	255.11	343.74
SPENDING ON PRODUCED INPUTS														
Seed	17.70	17.70	17.70	17.70	17.70	11.80	11.80	16.38	16.38	16.38	16.38	16.38	10.92	10.92
Herbicide	27.28	40.32	38.58	40.18	37.59	27.28	28.83	27.41	41.41	40.33	41.37	39.22	27.41	29.07
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	44.93	58.93	57.07	58.78	56.00	41.21	43.50	42.70	55.85	54.84	55.82	53.80	39.20	41.35
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	13.65	17.42	16.92	17.38	16.63	12.61	13.26	13.65	17.42	17.13	17.41	16.83	12.61	13.26
Machinery Fuel and Oil	n/a	9.55	9.42	9.54	9.35	n/a	8.47	n/a	9.98	9.90	9.98	9.82	n/a	8.84
Machinery Repairs and Maintenance	n/a	14.98	14.77	14.96	14.65	n/a	13.28	n/a	15.65	15.53	15.65	15.40	n/a	13.86
Irrigation Fuel and Oil	42.00	22.34	12.98	19.55	10.68	0.00	0.00	31.50	18.03	10.85	15.78	8.93	0.00	0.00
Irrigation Repairs and Maintenance	4.62	2.26	1.31	0.78	0.45	0.00	0.00	4.62	2.43	1.46	0.84	0.51	0.00	0.00
Water District Assessment	0.00	21.63	10.00	21.63	10.00	0.00	10.00	0.00	21.63	10.00	21.63	10.00	0.00	10.00
Spending on Produced Inputs $/acre		205.12	178.75	200.50	173.06		129.13		198.79	176.43	194.86	170.88		127.30
Value Added $/acre		22.68	42.49	26.78	44.44		44.27		252.79	267.65	256.47	265.43		216.44

Sources: KSU crop budgets and tables 15 through 18

Table 21: Kansas Soybean Crop Budgets Above Lovewell

	2005							2006						
	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-2602	MF-2602 Required	MF-2602 Actual	MF-2602 Required	MF-2602 Actual	MF-2160	MF-2160	MF-2602	MF-2602 Required	MF-2602 Actual	MF-2602 Required	MF-2602 Actual	MF-2160	MF-2160
Inches Water Applied	16	10.4	6.1	10.4	6.1	0	0	16	11.3	6.8	11.3	6.8	0	0
INCOME PER ACRE														
Yield per acre	55.0	63.0	59.1	62.2	58.0	36.0	43.0	55.0	63.0	60.2	62.5	59.0	36.0	43.0
Price per bushel	5.66	5.45	5.45	5.45	5.45	5.66	5.45	5.71	6.37	6.37	6.37	6.37	5.71	6.37
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	311.30	343.35	322.18	339.06	315.89	203.76	234.35	314.05	401.31	383.64	398.37	375.54	205.56	273.91
SPENDING ON PRODUCED INPUTS														
Seed	44.10	44.10	44.10	44.10	44.10	44.10	44.10	46.20	46.20	46.20	46.20	46.20	44.10	44.10
Herbicide	11.20	11.20	11.20	11.20	11.20	11.20	11.20	10.34	10.34	10.34	10.34	10.34	10.34	10.34
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	17.25	19.03	18.16	18.85	17.91	13.00	14.54	17.69	19.53	18.89	19.43	18.60	13.29	14.89
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery Fuel and Oil	n/a	7.09	6.96	7.07	6.92	n/a	6.37	n/a	7.46	7.36	7.44	7.32	n/a	6.71
Machinery Repairs and Maintenance	n/a	11.12	10.92	11.08	10.86	n/a	9.99	n/a	11.69	11.54	11.67	11.47	n/a	10.51
Irrigation Fuel and Oil	48.00	22.13	12.98	19.36	10.68	0.00	0.00	36.00	18.03	10.85	15.78	8.93	0.00	0.00
Irrigation Repairs and Maintenance	5.28	2.24	1.31	0.78	0.45	0.00	0.00	5.28	2.43	1.46	0.84	0.51	0.00	0.00
Water District Assessment	0.00	21.63	10.00	21.63	10.00	0.00	10.00	0.00	21.63	10.00	21.63	10.00	0.00	10.00
Spending on Produced Inputs $/acre		138.54	115.64	134.07	112.12		96.21		137.32	116.65	133.33	113.36		96.55
Value Added $/acre		204.81	206.55	204.99	203.77		138.14		263.99	266.99	265.05	262.18		177.36

Sources: KSU crop budgets and tables 15 through 18

Table 22: Kansas Alfalfa Hay Crop Budgets Above Lovewell

	2005					2006				
	KSU Base Budget	Center Pivot System	Center Pivot System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-584	MF-584 Required	MF-584 Actual	MF-363	MF-363	MF-584	MF-584 Required	MF-584 Actual	MF-363	MF-363
Inches Water Applied	24	10.5	6.1	0	0	24	11.3	6.8	0	0
INCOME PER ACRE										
Yield per acre	7.5	5.6	5.0	4.0	3.9	7.5	5.7	5.1	4.0	3.9
Price per ton	71.00	75.00	75.00	71.00	75.00	101.00	113.00	113.00	101.00	113.00
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	532.50	422.20	374.89	284.00	292.50	757.50	647.19	577.28	404.00	440.70
SPENDING ON PRODUCED INPUTS										
Seed	11.13	11.13	11.13	11.13	11.13	10.17	10.17	10.17	10.17	10.17
Herbicide	16.04	16.04	16.04	2.98	2.98	16.20	16.20	16.20	2.51	2.51
Insecticide/Fungicide	8.60	8.60	8.60	6.69	6.69	9.06	9.06	9.06	7.08	7.08
Fertilizer and Lime	31.25	23.11	20.36	31.83	30.53	32.38	24.39	21.60	33.88	32.48
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery Fuel and Oil	n/a	17.66	16.53	n/a	13.46	n/a	19.56	18.31	n/a	14.74
Machinery Repairs and Maintenance	n/a	27.69	25.91	n/a	21.11	n/a	30.67	28.70	n/a	23.10
Irrigation Fuel and Oil	162.00	22.34	12.98	0.00	0.00	122.16	18.03	10.85	0.00	0.00
Irrigation Repairs and Maintenance	7.92	2.26	1.31	0.00	0.00	7.92	2.43	1.46	0.00	0.00
Water District Assessment	0.00	21.63	10.00	0.00	10.00	0.00	21.63	10.00	0.00	10.00
Spending on Produced Inputs $/acre		150.46	122.86		95.90		152.15	126.35		100.08
Value Added $/acre		271.75	252.03		196.60		495.04	450.93		340.62

Sources: KSU crop budgets and tables 15 through 18

Table 23: Prevented Planting Budgets Above Lovewell

INCOME PER ACRE	2005 KSU Base Cane Hay Budget MF-997	Prevented Planting with Cane Hay	Prevented Planting with Fallow	Composite with Hay & Fallow	2005 KSU Base Cane Hay Budget MF-997	Prevented Planting with Cane Hay	Prevented Planting with Fallow	Composite with Hay & Fallow
			%Fallow = 50%				%Fallow = 50%	
Yield per acre	2.75	2.75			2.75	2.75		
Price per ton	43.86	43.86			51.03	51.03		
Indemnity payments	0.00	180.07	180.07	180.07	0.00	240.15	240.15	240.15
Gross Returns	120.62	300.69	180.07	240.38	140.33	380.48	240.15	310.32
SPENDING ON PRODUCED INPUTS								
Seed	10.73	10.73	0.00	5.36	14.40	14.40	0.00	7.20
Herbicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	35.03	35.03	0.00	17.52	33.30	33.30	0.00	16.65
Crop Insurance	0.00	31.89	31.89	31.89	0.00	42.53	42.53	42.53
Drying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery Fuel and Oil	n/a	11.15	4.72	7.94	n/a	12.12	5.13	8.63
Machinery Repairs and Maintenance	n/a	17.48	7.40	12.44	n/a	19.01	8.05	13.53
Irrigation Fuel and Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation Repairs and Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water District Assessment		10.00	10.00	10.00		10.00	10.00	10.00
Spending on Produced Inputs $/acre		116.28	54.01	85.14		131.36	65.71	98.54
Value Added $/acre		184.41	126.06	155.24		249.12	174.44	211.78

Sources: KSU crop budgets and tables 8 and 15 through 18

Table 24: Kansas Corn Crop Budgets Below Lovewell

	2005							2006						
	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-2601	MF-2601 Required	MF-2601 Actual	MF-2601 Required	MF-2601 Actual	MF-2161	MF-2161	MF-2601	MF-2601 Required	MF-2601 Actual	MF-2601 Required	MF-2601 Actual	MF-2161	MF-2161
Inches Water Applied	16	10.5	6.2	10.5	6.2	0	0	16	11.3	7.7	11.3	7.7	0	0
INCOME PER ACRE														
Yield per acre	175.0	179.2	156.0	172.4	151.7	104.0	98.0	175.0	181.3	166.0	174.9	160.4	104.0	98.0
Price per bushel	2.32	2.07	2.07	2.07	2.07	2.32	2.07	2.71	3.08	3.08	3.08	3.08	2.71	3.08
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	406.00	371.02	322.82	356.93	314.09	241.28	202.86	474.25	558.40	511.24	538.73	494.07	281.84	301.84
SPENDING ON PRODUCED INPUTS														
Seed	54.00	54.00	54.00	54.00	54.00	43.20	43.20	57.30	57.30	57.30	57.30	57.30	45.84	45.84
Herbicide	29.66	29.66	29.66	29.66	29.66	29.66	29.66	30.80	30.80	30.80	30.80	30.80	30.80	30.80
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	77.50	79.45	68.71	76.31	66.77	44.40	41.66	73.11	75.83	69.22	73.07	66.81	42.11	39.54
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	22.75	23.30	20.27	22.42	19.73	13.52	12.74	22.75	23.57	21.58	22.74	20.85	13.52	12.74
Machinery Fuel and Oil	n/a	10.84	10.07	10.61	9.93	n/a	8.18	n/a	11.38	10.86	11.17	10.67	n/a	8.58
Machinery Repairs and Maintenance	n/a	16.99	15.78	16.64	15.56	n/a	12.83	n/a	17.85	17.03	17.51	16.73	n/a	13.46
Irrigation Fuel and Oil	48.00	22.34	13.19	19.55	10.85	0.00	0.00	36.00	18.03	12.29	15.78	10.11	0.00	0.00
Irrigation Repairs and Maintenance	5.28	2.26	1.33	0.78	0.46	0.00	0.00	5.28	2.43	1.66	0.84	0.57	0.00	0.00
Water District Assessment	0.00	21.63	10.00	21.63	10.00	0.00	10.00	0.00	21.63	10.00	21.63	10.00	0.00	10.00
Spending on Produced Inputs $/acre		260.47	223.02	251.60	216.95		158.27		258.83	230.73	250.83	223.85		160.96
Value Added $/acre		110.55	99.80	105.33	97.14		44.59		299.57	280.51	287.89	270.22		140.88

Sources: KSU crop budgets and tables 15 through 18

Table 25: Kansas Milo Crop Budgets Below Lovewell

	2005							2006						
	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-2600	MF-2600 Required	MF-2600 Actual	MF-2600 Required	MF-2600 Actual	MF-2159	MF-2159	MF-2600	MF-2600 Required	MF-2600 Actual	MF-2600 Required	MF-2600 Actual	MF-2159	MF-2159
Inches Water Applied	14	10.5	6.2	10.5	6.2	0	0	14	11.3	7.7	11.3	7.7	0	0
INCOME PER ACRE														
Yield per acre	105.0	134.0	130.4	133.7	128.2	97.0	102.0	105.0	134.0	133.3	133.9	131.1	97.0	102.0
Price per bushel	2.25	1.70	1.70	1.70	1.70	2.25	1.70	2.63	3.37	3.37	3.37	3.37	2.63	3.37
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	236.25	227.80	221.68	227.28	217.90	218.25	173.40	276.15	451.58	449.13	451.33	441.68	255.11	343.74
SPENDING ON PRODUCED INPUTS														
Seed	17.70	17.70	17.70	17.70	17.70	11.80	11.80	16.38	16.38	16.38	16.38	16.38	10.92	10.92
Herbicide	27.28	40.32	38.70	40.18	37.70	27.28	28.83	27.41	41.41	41.06	41.37	39.99	27.41	29.07
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	44.93	58.93	57.19	58.78	56.12	41.21	43.50	42.70	55.85	55.53	55.82	54.52	39.20	41.35
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	13.65	17.42	16.95	17.38	16.66	12.61	13.26	13.65	17.42	17.33	17.41	17.04	12.61	13.26
Machinery Fuel and Oil	n/a	9.55	9.43	9.54	9.36	n/a	8.47	n/a	9.98	9.96	9.98	9.88	n/a	8.84
Machinery Repairs and Maintenance	n/a	14.98	14.79	14.96	14.67	n/a	13.28	n/a	15.65	15.61	15.65	15.49	n/a	13.86
Irrigation Fuel and Oil	42.00	22.34	13.19	19.55	10.85	0.00	0.00	31.50	18.03	12.29	15.78	10.11	0.00	0.00
Irrigation Repairs and Maintenance	4.62	2.26	1.33	0.78	0.46	0.00	0.00	4.62	2.43	1.66	0.84	0.57	0.00	0.00
Water District Assessment	0.00	21.63	10.00	21.63	10.00	0.00	10.00	0.00	21.63	10.00	21.63	10.00	0.00	10.00
Spending on Produced Inputs $/acre		205.12	179.28	200.50	173.51		129.13		198.79	179.80	194.86	173.97		127.30
Value Added $/acre		22.68	42.40	26.78	44.39		44.27		252.79	269.34	256.47	267.70		216.44

Sources: KSU crop budgets and tables 15 through 18

Table 26: Kansas Soybean Crop Budgets Below Lovewell

	2005							2006						
	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-2602	MF-2602 Required	MF-2602 Actual	MF-2602 Required	MF-2602 Actual	MF-2160	MF-2160	MF-2602	MF-2602 Required	MF-2602 Actual	MF-2602 Required	MF-2602 Actual	MF-2160	MF-2160
Inches Water Applied	16	10.5	6.2	10.5	6.2	0	0	16	11.3	7.7	11.3	7.7	0	0
INCOME PER ACRE														
Yield per acre	55.0	63.0	59.3	62.2	58.1	36.0	43.0	55.0	63.0	61.4	62.5	60.0	36.0	43.0
Price per bushel	5.66	5.45	5.45	5.45	5.45	5.66	5.45	5.71	6.37	6.37	6.37	6.37	5.71	6.37
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	311.30	343.35	323.10	339.06	316.71	203.76	234.35	314.05	401.31	391.13	398.37	382.48	205.56	273.91
SPENDING ON PRODUCED INPUTS														
Seed	44.10	44.10	44.10	44.10	44.10	44.10	44.10	46.20	46.20	46.20	46.20	46.20	44.10	44.10
Herbicide	11.20	11.20	11.20	11.20	11.20	11.20	11.20	10.34	10.34	10.34	10.34	10.34	10.34	10.34
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	17.25	19.03	18.20	18.85	17.94	13.00	14.54	17.69	19.53	19.16	19.43	18.85	13.29	14.89
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery Fuel and Oil	n/a	7.09	6.97	7.07	6.93	n/a	6.37	n/a	7.46	7.40	7.44	7.35	n/a	6.71
Machinery Repairs and Maintenance	n/a	11.12	10.93	11.08	10.86	n/a	9.99	n/a	11.69	11.61	11.67	11.53	n/a	10.51
Irrigation Fuel and Oil	48.00	22.34	13.19	19.55	10.85	0.00	0.00	36.00	18.03	12.29	15.78	10.11	0.00	0.00
Irrigation Repairs and Maintenance	5.28	2.26	1.33	0.78	0.46	0.00	0.00	5.28	2.43	1.66	0.84	0.57	0.00	0.00
Water District Assessment	0.00	21.63	10.00	21.63	10.00	0.00	10.00	0.00	21.63	10.00	21.63	10.00	0.00	10.00
Spending on Produced Inputs $/acre		138.77	115.92	134.26	112.35		96.21		137.32	118.66	133.33	114.96		96.55
Value Added $/acre		204.58	207.18	204.80	204.36		138.14		263.99	272.47	265.05	267.52		177.36

Sources: KSU crop budgets and tables 15 through 18

Table 27: Kansas Alfalfa Hay Crop Budgets Below Lovewell

	2005 KSU Base Budget	Center Pivot System	Center Pivot System	KSU Base Budget	Non Irrigated	2006 KSU Base Budget	Center Pivot System	Center Pivot System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-584	MF-584 Required	MF-584 Actual	MF-363	MF-363	MF-584	MF-584 Required	MF-584 Actual	MF-363	MF-363
Inches Water Applied	24	10.5	6.2	0	0	24	11.3	7.7	0	0
INCOME PER ACRE										
Yield per acre	7.5	5.6	5.0	4.0	3.9	7.5	5.7	5.2	4.0	3.9
Price per bushel	71.00	75.00	75.00	71.00	75.00	101.00	113.00	113.00	101.00	113.00
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	532.50	422.20	376.08	284.00	292.50	757.50	647.19	592.69	404.00	440.70
SPENDING ON PRODUCED INPUTS										
Seed	11.13	11.13	11.13	11.13	11.13	10.17	10.17	10.17	10.17	10.17
Herbicide	16.04	16.04	16.04	2.98	2.98	16.20	16.20	16.20	2.51	2.51
Insecticide/Fungicide	8.60	8.60	8.60	6.69	6.69	9.06	9.06	9.06	7.08	7.08
Fertilizer and Lime	31.25	23.11	20.43	31.83	30.53	32.38	24.39	22.21	33.88	32.48
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery Fuel and Oil	n/a	17.66	16.55	n/a	13.46	n/a	19.56	18.58	n/a	14.74
Machinery Repairs and Maintenance	n/a	27.69	25.95	n/a	21.11	n/a	30.67	29.13	n/a	23.10
Irrigation Fuel and Oil	162.00	22.34	13.19	0.00	0.00	122.16	18.03	12.29	0.00	0.00
Irrigation Repairs and Maintenance	7.92	2.26	1.33	0.00	0.00	7.92	2.43	1.66	0.00	0.00
Water District Assessment	0.00	21.63	10.00	0.00	10.00	0.00	21.63	10.00	0.00	10.00
Spending on Produced Inputs $/acre		150.46	123.24		95.90		152.15	129.31		100.08
Value Added $/acre		271.75	252.85		196.60		495.04	463.38		340.62

Sources: KSU crop budgets and tables 15 through 18

Table 28: Prevented Planting Budgets Below Lovewell

INCOME PER ACRE	2005 KSU Base Cane Hay Budget MF-997	Prevented Planting with Cane Hay	Prevented Planting with Fallow	Composite with Hay & Fallow	2006 KSU Base Cane Hay Budget MF-997	Prevented Planting with Cane Hay	Prevented Planting with Fallow	Composite with Hay & Fallow
			%Fallow = 50%				%Fallow = 50%	
Yield per acre	2.75	2.75			2.75	2.75		
Price per bushel	43.86	43.86			$51.03	51.03		
Indemnity payments	0.00	180.07	180.07	180.07	$0.00	240.15	240.15	240.15
Gross Returns	134.01	300.69	180.07	240.38	134.01	380.48	240.15	310.32
SPENDING ON PRODUCED INPUTS								
Seed	10.73	10.73	0.00	5.36	$14.40	14.40	0.00	7.20
Herbicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	35.03	35.03	0.00	17.52	33.30	33.30	0.00	16.65
Crop Insurance	0.00	31.89	31.89	31.89	0.00	42.53	42.53	42.53
Drying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery Fuel and Oil	n/a	11.15	4.72	7.94	n/a	12.12	5.13	8.63
Machinery Repairs and Maintenance	n/a	17.48	7.40	12.44	n/a	19.01	8.05	13.53
Irrigation Fuel and Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation Repairs and Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water District Assessment		10.00	10.00	10.00		10.00	10.00	10.00
Spending on Produced Inputs $/acre		116.28	54.01	85.14		131.36	65.71	98.54
Value Added $/acre		184.41	126.06	155.24		249.12	174.44	211.78

Sources: KSU crop budgets and tables 8 and 15 through 18

Table 29: Effects Above Lovewell in 2005

Crops Actually Grown	Crops Actual Water							Dryland Crops					Dry/
	Corn		Milo		Soybeans		Alfalfa	Corn	Milo	Soybeans	Alfalfa	Prevented	Actual
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot	Dry	Dry	Dry	Dry	Planting	Total
Acres Affected	568		89		318		132	2,326	3,518	3,116	898	1,997	
Acres Affected, by System	285	284	44	44	159	159	132	2,326	3,518	3,116	898	1,997	12,962
Gross Returns	321.31	312.77	221.25	217.50	322.18	315.89	374.89	202.86	173.40	234.35	292.50	240.38	2,905,311
												0.00	
SPENDING ON PRODUCED INPUTS												0.00	
Seed	54.00	54.00	17.70	17.70	44.10	44.10	11.13	43.20	11.80	44.10	11.13	5.36	347,886
Herbicide	29.66	29.66	38.58	37.59	11.20	11.20	16.04	29.66	28.83	11.20	2.98	0.00	233,880
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	8.60	0.00	0.00	0.00	6.69	0.00	7,139
Fertilizer and Lime	68.38	66.47	57.07	56.00	18.16	17.91	20.36	41.66	43.50	14.54	30.53	17.52	409,382
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.89	63,676
Drying	20.18	19.64	16.92	16.63	0.00	0.00	0.00	12.74	13.26	0.00	0.00	0.00	89,082
Machinery Fuel and Oil	10.04	9.90	9.42	9.35	6.96	6.92	16.53	8.18	8.47	6.37	13.46	7.94	107,503
Machinery Repairs and Maintenance	15.74	15.53	14.77	14.65	10.92	10.86	25.91	12.83	13.28	9.99	21.11	12.44	168,543
Irrigation Fuel and Oil	12.98	10.68	12.98	10.68	12.98	10.68	12.98	0.00	0.00	0.00	0.00	0.00	13,247
Irrigation Repairs and Maintenance	1.31	0.45	1.31	0.45	1.31	0.45	1.31	0.00	0.00	0.00	0.00	0.00	1,035
Water District Assessment	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	129,617
Spending on Produced Inputs $/acre	222.29	216.34	178.75	173.06	115.64	112.12	122.86	158.27	129.13	96.21	95.90	85.14	
Value Added $/acre	99.02	96.43	42.49	44.44	206.55	203.77	252.03	44.59	44.27	138.14	196.60	155.24	
Total Spending on Produced Inputs	63,243	61,398	7,926	7,654	18,432	17,827	16,184	368,122	454,279	299,820	86,098	170,007	1,570,990
Total Value Added	28,172	27,368	1,884	1,965	32,922	32,399	33,200	103,718	155,731	430,493	176,507	309,962	1,334,321

Crops That Should Have Been Grown	Crops Required Water							Required	Dry/Actual	Difference
	Corn		Milo		Soybeans		Alfalfa	Water	Total	from Water
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot	Total	(from above)	Shortage
Acres Affected	7,426		144		4,540		851			
Acres Affected, by System	3,718	3,709	72	72	2,273	2,267	851	12,962	12,962	
Gross Returns	371.02	356.93	227.80	227.28	343.35	339.06	422.20	4,644,404	2,905,311	1,739,093
SPENDING ON PRODUCED INPUTS										
Seed	54.00	54.00	17.70	17.70	44.10	44.10	11.13	613,268	347,886	265,382
Herbicide	29.66	29.66	40.32	40.18	11.20	11.20	16.04	290,560	233,880	56,680
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	8.60	7,322	7,139	183
Fertilizer and Lime	79.45	76.31	58.93	58.78	19.03	18.85	23.11	692,550	409,382	283,167
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	63,676	-63,676
Drying	23.30	22.42	17.42	17.38	0.00	0.00	0.00	172,263	89,082	83,181
Machinery Fuel and Oil	10.84	10.61	9.55	9.54	7.09	7.07	17.66	128,198	107,503	20,695
Machinery Repairs and Maintenance	16.99	16.64	14.98	14.96	11.12	11.08	27.69	200,988	168,543	32,445
Irrigation Fuel and Oil	22.34	19.55	22.34	19.55	22.13	19.36	22.34	271,776	13,247	258,530
Irrigation Repairs and Maintenance	2.26	0.78	2.26	0.78	2.24	0.78	2.26	20,291	1,035	19,256
Water District Assessment	21.63	21.63	21.63	21.63	21.63	21.63	21.63	280,362	129,617	150,745
Spending on Produced Inputs $/acre	260.47	251.60	205.12	200.50	138.54	134.07	150.46			
Value Added $/acre	110.55	105.33	22.68	26.78	204.81	204.99	271.75			
Total Spending on Produced Inputs	968,394	933,092	14,764	14,396	314,877	303,960	128,095	2,677,578	1,570,990	1,106,588
Total Value Added	410,997	390,638	1,632	1,923	465,512	464,763	231,360	1,966,826	1,334,321	632,505

Sources: Tables 11 and 18 through 28

Table 30: Effects Above Lovewell in 2006

Crops Actually Grown	Crops Actual Water							Dryland Crops					Dry/
	Corn Pivot	Furrow	Milo Pivot	Furrow	Soybeans Pivot	Furrow	Alfalfa Pivot	Corn Dry	Milo Dry	Soybeans Dry	Alfalfa Dry	Prevented Planting	Actual Total
Acres Affected	3,042		474		1,704		705	1,122	1,548	2,305	717	1,328	
Acres Affected, by System	1,523	1,519	237	237	853	851	705	1,122	1,548	2,305	717	1,328	12,946
Gross Returns	493.36	478.63	444.07	436.31	383.64	375.54	577.28	301.84	343.74	273.91	440.70	310.32	4,971,238
SPENDING ON PRODUCED INPUTS													
Seed	57	57.30	16.38	16.38	46.20	46.20	10.17	45.84	10.92	44.10	10.17	7.20	454,807
Herbicide	31	30.80	40.33	39.22	10.34	10.34	16.20	30.80	29.07	10.34	2.51	0.00	246,771
Insecticide/Fungicide	0	0.00	0.00	0.00	0.00	0.00	9.06	0.00	0.00	0.00	7.08	0.00	11,467
Fertilizer and Lime	67	64.64	54.84	53.80	18.89	18.60	21.60	39.54	41.35	14.89	32.48	16.65	460,792
Crop Insurance	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.53	56,490
Drying	20.82	20.20	17.13	16.83	0.00	0.00	0.00	12.74	13.26	0.00	0.00	0.00	105,262
Machinery Fuel and Oil	10.66	10.50	9.90	9.82	7.36	7.32	18.31	8.58	8.84	6.71	14.74	8.63	123,087
Machinery Repairs and Maintenance	16.72	16.46	15.53	15.40	11.54	11.47	28.70	13.46	13.86	10.51	23.10	13.53	192,976
Irrigation Fuel and Oil	10.85	8.93	10.85	8.93	10.85	8.93	10.85	0.00	0.00	0.00	0.00	0.00	59,272
Irrigation Repairs and Maintenance	1.46	0.51	1.46	0.51	1.46	0.51	1.46	0.00	0.00	0.00	0.00	0.00	6,177
Water District Assessment	10	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	129,456
Spending on Produced Inputs $/acre	225.33	219.34	176.43	170.88	116.65	113.36	126.35	160.96	127.30	96.55	100.08	98.54	
Value Added $/acre	268.03	259.29	267.65	265.43	266.99	262.18	450.93	140.88	216.44	177.36	340.62	211.78	
Total Spending on Produced Inputs	343,094	333,152	41,865	40,449	99,508	96,465	89,076	180,639	197,052	222,577	71,802	130,878	1,846,556
Total Value Added	408,111	393,825	63,510	62,829	227,757	223,101	317,905	158,105	335,016	408,868	244,365	281,290	3,124,682

Crops That Should Have Been Grown	Crops Required Water							Required Water Total	Dry/Actual Total (from above)	Difference from Water Shortage
	Corn Pivot	Furrow	Milo Pivot	Furrow	Soybeans Pivot	Furrow	Alfalfa Pivot			
Acres Affected	7,417		144		4,535		850			
Acres Affected, by System	3,713	3,704	72	72	2,270	2,265	850	12,946	12,946	
Gross Returns	558.40	538.73	451.58	451.33	401.31	398.37	647.19	6,497,380	4,971,238	1,526,143
SPENDING ON PRODUCED INPUTS										
Seed	57.30	57.30	16.38	16.38	46.20	46.20	10.17	645,523	454,807	190,715
Herbicide	30.80	30.80	41.41	41.37	10.34	10.34	16.20	295,066	246,771	48,295
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	9.06	7,704	11,467	-3,762
Fertilizer and Lime	75.83	73.07	55.85	55.82	19.53	19.43	24.39	669,344	460,792	208,552
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	56,490	-56,490
Drying	23.57	22.74	17.42	17.41	0.00	0.00	0.00	174,247	105,262	68,985
Machinery Fuel and Oil	11.38	11.17	9.98	9.98	7.46	7.44	19.56	135,493	123,087	12,405
Machinery Repairs and Maintenance	17.85	17.51	15.65	15.65	11.69	11.67	30.67	212,425	192,976	19,449
Irrigation Fuel and Oil	18.03	15.78	18.03	15.78	18.03	15.78	18.03	219,828	59,272	160,556
Irrigation Repairs and Maintenance	2.43	0.84	2.43	0.84	2.43	0.84	2.43	21,882	6,177	15,705
Water District Assessment	21.63	21.63	21.63	21.63	21.63	21.63	21.63	280,024	129,456	150,568
Spending on Produced Inputs $/acre	258.83	250.83	198.79	194.86	137.32	133.33	152.15			
Value Added $/acre	299.57	287.89	252.79	256.47	263.99	265.05	495.04			
Total Spending on Produced Inputs	961,116	929,131	14,291	13,974	311,726	301,918	129,379	2,661,535	1,846,556	814,979
Total Value Added	1,112,419	1,066,401	18,174	18,392	599,297	600,203	420,959	3,835,846	3,124,682	711,164

Sources: Tables 11 and 18 through 28

Table 31: Effects Below Lovewell in 2005

Crops Actually Grown	Crops Actual Water							Dryland Crops					Dry/
	Corn		Milo		Soybeans		Alfalfa	Corn	Milo	Soybeans	Alfalfa	Prevented	Actual
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot	Dry	Dry	Dry	Dry	Planting	Total
Acres Affected	12,620		1,438		7,694		1,686	394	596	528	152	338	
Acres Affected, by System	6,041	6,579	688	750	3,683	4,011	1,686	394	596	528	152	338	25,447
Gross Returns	322.82	314.09	221.68	217.90	323.10	316.71	376.08	202.86	173.40	234.35	292.50	240.38	7,859,745
SPENDING ON PRODUCED INPUTS													
Seed	54.00	54.00	17.70	17.70	44.10	44.10	11.13	43.20	11.80	44.10	11.13	5.36	1,115,853
Herbicide	29.66	29.66	38.70	37.70	11.20	11.20	16.04	29.66	28.83	11.20	2.98	0.00	577,660
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	8.60	0.00	0.00	0.00	6.69	0.00	15,517
Fertilizer and Lime	68.71	66.77	57.19	56.12	18.20	17.94	20.43	41.66	43.50	14.54	30.53	17.52	1,169,846
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.89	10,789
Drying	20.27	19.73	16.95	16.66	0.00	0.00	0.00	12.74	13.26	0.00	0.00	0.00	289,334
Machinery Fuel and Oil	10.07	9.93	9.43	9.36	6.97	6.93	16.55	8.18	8.47	6.37	13.46	7.94	237,348
Machinery Repairs and Maintenance	15.78	15.56	14.79	14.67	10.93	10.86	25.95	12.83	13.28	9.99	21.11	12.44	372,113
Irrigation Fuel and Oil	13.19	10.85	13.19	10.85	13.19	10.85	13.19	0.00	0.00	0.00	0.00	0.00	282,658
Irrigation Repairs and Maintenance	1.33	0.46	1.33	0.46	1.33	0.46	1.33	0.00	0.00	0.00	0.00	0.00	21,384
Water District Assessment	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	254,466
Spending on Produced Inputs $/acre	223.02	216.95	179.28	173.51	115.92	112.35	123.24	158.27	129.13	96.21	95.90	85.14	
Value Added $/acre	99.80	97.14	42.40	44.39	207.18	204.36	252.85	44.59	44.27	138.14	196.60	155.24	
Total Spending on Produced Inputs	1,347,354	1,427,249	123,417	130,067	426,971	450,603	207,777	62,371	76,969	50,799	14,588	28,805	4,346,968
Total Value Added	602,962	639,022	29,187	33,271	763,092	819,621	426,301	17,573	26,386	72,939	29,906	52,517	3,512,777

Crops That Should Have Been Grown	Crops Required Water							Required	Dry/Actual	Difference
	Corn		Milo		Soybeans		Alfalfa	Water	Total	from Water
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot	Total	(from above)	Shortage
Acres Affected	13,964		329		9,621		1,534			
Acres Affected, by System	6,685	7,279	157	171	4,606	5,015	1,534	25,448	25,447	
Gross Returns	371.02	356.93	227.80	227.28	343.35	339.06	422.20	9,082,597	7,859,745	1,222,851
SPENDING ON PRODUCED INPUTS										
Seed	54.00	54.00	17.70	17.70	44.10	44.10	11.13	1,201,236	1,115,853	85,383
Herbicide	29.66	29.66	40.32	40.18	11.20	11.20	16.04	559,758	577,660	-17,901
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	8.60	13,190	15,517	-2,327
Fertilizer and Lime	79.45	76.31	58.93	58.78	19.03	18.85	23.11	1,323,629	1,169,846	153,782
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	10,789	-10,789
Drying	23.30	22.42	17.42	17.38	0.00	0.00	0.00	324,652	289,334	35,318
Machinery Fuel and Oil	10.84	10.61	9.55	9.54	7.09	7.07	17.66	248,025	237,348	10,677
Machinery Repairs and Maintenance	16.99	16.64	14.98	14.96	11.12	11.08	27.69	388,853	372,113	16,740
Irrigation Fuel and Oil	22.34	19.55	22.34	19.55	22.34	19.55	22.34	533,698	282,658	251,040
Irrigation Repairs and Maintenance	2.26	0.78	2.26	0.78	2.26	0.78	2.26	39,092	21,384	17,708
Water District Assessment	21.63	21.63	21.63	21.63	21.63	21.63	21.63	550,431	254,466	295,965
Spending on Produced Inputs $/acre	260.47	251.60	205.12	200.50	138.77	134.26	150.46			
Value Added $/acre	110.55	105.33	22.68	26.78	204.58	204.80	271.75			
Total Spending on Produced Inputs	1,741,221	1,831,442	32,279	34,357	639,156	673,353	230,755	5,182,563	4,346,968	835,595
Total Value Added	738,994	766,732	3,569	4,589	942,250	1,027,120	416,782	3,900,033	3,512,777	387,256

Sources: Tables 11 and 18 through 28

Table 32: Effects Below Lovewell in 2006

Crops Actually Grown	Crops Actual Water							Dryland Crops					Dry/
	Corn		Milo		Soybeans		Alfalfa	Corn	Milo	Soybeans	Alfalfa	Prevented	Actual
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot	Dry	Dry	Dry	Dry	Planting	Total
Acres Affected	10,448		310		9,803		2,092	442	609	907	282	523	
Acres Affected, by System	5,002	5,447	148	162	4,693	5,110	2,092	442	609	907	282	523	25,416
Gross Returns	511.24	494.07	449.13	441.68	391.13	382.48	592.69	301.84	343.74	273.91	440.70	310.32	11,293,848
SPENDING ON PRODUCED INPUTS													
Seed	57.30	57.30	16.38	16.38	46.20	46.20	10.17	45.84	10.92	44.10	10.17	7.20	1,151,480
Herbicide	30.80	30.80	41.06	39.99	10.34	10.34	16.20	30.80	29.07	10.34	2.51	0.00	511,015
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	9.06	0.00	0.00	0.00	7.08	0.00	20,952
Fertilizer and Lime	69.22	66.81	55.53	54.52	19.16	18.85	22.21	39.54	41.35	14.89	32.48	16.65	1,033,886
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.53	22,229
Drying	21.58	20.85	17.33	17.04	0.00	0.00	0.00	12.74	13.26	0.00	0.00	0.00	240,540
Machinery Fuel and Oil	10.86	10.67	9.96	9.88	7.40	7.35	18.58	8.58	8.84	6.71	14.74	8.63	250,662
Machinery Repairs and Maintenance	17.03	16.73	15.61	15.49	11.61	11.53	29.13	13.46	13.86	10.51	23.10	13.53	392,987
Irrigation Fuel and Oil	12.29	10.11	12.29	10.11	12.29	10.11	12.29	0.00	0.00	0.00	0.00	0.00	254,994
Irrigation Repairs and Maintenance	1.66	0.57	1.66	0.57	1.66	0.57	1.66	0.00	0.00	0.00	0.00	0.00	25,930
Water District Assessment	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	254,163
Spending on Produced Inputs $/acre	230.73	223.85	179.80	173.97	118.66	114.96	129.31	160.96	127.30	96.55	100.08	98.54	
Value Added $/acre	280.51	270.22	269.34	267.70	272.47	267.52	463.38	140.88	216.44	177.36	340.62	211.78	
Total Spending on Produced Inputs	1,154,080	1,219,200	26,682	28,114	556,836	587,453	270,507	71,083	77,541	87,586	28,255	51,502	4,158,839
Total Value Added	1,403,065	1,471,795	39,970	43,260	1,278,690	1,367,045	969,395	62,216	131,832	160,893	96,159	110,690	7,135,009

Crops That Should Have Been Grown	Crops Required Water							Required	Dry/Actual	Difference
	Corn		Milo		Soybeans		Alfalfa	Water	Total	from Water
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot	Total	(from above)	Shortage
Acres Affected	13,947		328		9,610		1,532			
Acres Affected, by System	6,677	7,270	157	171	4,600	5,009	1,532	25,417	25,416	
Gross Returns	558.40	538.73	451.58	451.33	401.31	398.37	647.19	12,626,392	11,293,848	1,332,544
SPENDING ON PRODUCED INPUTS										
Seed	57.30	57.30	16.38	16.38	46.20	46.20	10.17	1,264,089	1,151,480	112,608
Herbicide	30.80	30.80	41.41	41.37	10.34	10.34	16.20	567,339	511,015	56,324
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	9.06	13,879	20,952	-7,074
Fertilizer and Lime	75.83	73.07	55.85	55.82	19.53	19.43	24.39	1,280,422	1,033,886	246,536
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	22,229	-22,229
Drying	23.57	22.74	17.42	17.41	0.00	0.00	0.00	328,400	240,540	87,860
Machinery Fuel and Oil	11.38	11.17	9.98	9.98	7.46	7.44	19.56	262,036	250,662	11,374
Machinery Repairs and Maintenance	17.85	17.51	15.65	15.65	11.69	11.67	30.67	410,820	392,987	17,832
Irrigation Fuel and Oil	18.03	15.78	18.03	15.78	18.03	15.78	18.03	430,251	254,994	175,257
Irrigation Repairs and Maintenance	2.43	0.84	2.43	0.84	2.43	0.84	2.43	42,020	25,930	16,090
Water District Assessment	21.63	21.63	21.63	21.63	21.63	21.63	21.63	549,767	254,163	295,604
Spending on Produced Inputs $/acre	258.83	250.83	198.79	194.86	137.32	133.33	152.15			
Value Added $/acre	299.57	287.89	252.79	256.47	263.99	265.05	495.04			
Total Spending on Produced Inputs	1,728,134	1,823,669	31,244	33,349	631,692	667,865	233,068	5,149,021	4,158,839	990,182
	2,000,185	2,093,097	39,733	43,894	1,214,436	1,327,694	758,332	7,477,371	7,135,009	342,362

Sources: Tables 11 and 18 through 28

Table 33: Overall Summary of Changes in Purchases and Value Added for KBID

	Above Lovewell		Below Lovewell		
	2,005	2006	2,005	2006	Totals
Gross Returns	1,739,093	1,526,143	1,222,851	1,332,544	5,820,631
Expenses per Planted Acre					
Seed	265,382	190,715	85,383	112,608	654,088
Herbicide	56,680	48,295	-17,901	56,324	143,398
Insecticide/Fungicide	183	-3,762	-2,327	-7,074	-12,981
Fertilizer and Lime	283,167	208,552	153,782	246,536	892,038
Crop Insurance	-63,676	-56,490	-10,789	-22,229	-153,183
Drying	83,181	68,985	35,318	87,860	275,344
Machinery Fuel and Oil	20,695	12,405	10,677	11,374	55,151
Machinery Repairs and Maintenance	32,445	19,449	16,740	17,832	86,466
Irrigation Fuel and Oil	258,530	160,556	251,040	175,257	845,382
Irrigation Repairs and Maintenance	19,256	15,705	17,708	16,090	68,758
Water District Assessment	150,745	150,568	295,965	295,604	892,882
Total Spending on Produced Inputs	1,106,588	814,979	835,595	990,182	3,747,344
Total Value Added	632,505	711,164	387,256	342,362	2,073,287

Sources: Tables 29 through 32

Table 34: Acreage and Water Use Outside KBID

Acre Feet	2005	2006
Average 1994-04	5,375	5,375
Actual acre feet	3,648	3,270
Potential Additional	1,727	2,105
Acres		
Average 1994-04	6,256	6,256
Actual acres	5,330	4,826
Potential Additional	926	1,430
Inches		
Rate with Required Water	10.3	10.3
Actual Rate	8.2	8.1

Source: SWE Kansas Losses report. Appendix E

Table 35: Scenarios Outside KBID with Required Water

2005				
5,330	acres from	8.2	inches to	10.3 inches
926	acres from	0	inches to	10.3 inches
2006				
4,826	acres from	8.1	inches to	10.3 inches
1,430	acres from	0	inches to	10.3 inches

Source: Table 34

Table 36: Crop Mix to Use Outside KBID

	Corn	Milo	Soybeans	Alfalfa	Total
Required Water Mix (Average Mix Above & Below Lovewell, computed from tables 1&2)					
2010	55.5%	1.2%	37.1%	6.2%	100.0%
Actual Mix (Crop Mix Below Lovewell from Table 4)					
2005	53.8%	6.1%	32.8%	7.2%	100.0%
2006	46.1%	1.4%	43.3%	9.2%	100.0%
Dryland Crop Mix (Jewell & Republic NASS from table 9)					
2005	23.6%	35.7%	31.6%	9.1%	100.0%
2006	19.7%	27.2%	40.5%	12.6%	100.0%
2005 Acres Required Water	3,474	78	2,318	386	6,256
Acres Actual Water	2,870	327	1,750	383	5,330
Acres Dryland	218	330	293	84	926
2006 Acres Required Water	3,474	78	2,318	386	6,256
Acres Actual Water	2,226	66	2,088	446	4,826
Acres Dryland	282	389	579	180	1,430

Sources: Tables 1, 2, 4, 9 and 35

Table 37: Estimates from Yield Model for Crops Outside KBID

Yields for Dryland Crops

		2005	2006
Corn (& Silage)	bushels/acre	98.0	98.0
Milo (& Sunflower)	bushels/acre	102.0	102.0
Soybeans	bushels/acre	43.0	43.0
Alfalfa	tons/acre	3.9	3.9

Crop Yields with Actual Water Rates

Pivot		2005	2006
Corn (& Silage)	bushels/acre	169.0	168.5
Milo (& Sunflower)	bushels/acre	133.8	133.7
Soybeans	bushels/acre	61.9	61.9
Alfalfa	tons/acre	5.3	5.3

Furrow		2005	2006
Corn (& Silage)	bushels/acre	163.0	162.6
Milo (& Sunflower)	bushels/acre	131.8	131.7
Soybeans	bushels/acre	60.6	60.5

Crop Yields with Required Water Rates

Pivot		2005	2006
Corn (& Silage)	bushels/acre	178.6	178.6
Milo (& Sunflower)	bushels/acre	134.0	134.0
Soybean	bushels/acre	63.0	63.0
Alfalfa	tons/acre	5.6	5.6

Furrow		2005	2006
Corn (& Silage)	bushels/acre	171.8	171.8
Milo (& Sunflower)	bushels/acre	133.6	133.6
Soybean	bushels/acre	62.1	62.1

Sources: Tables 13 and 34

Table 38: Kansas Corn Crop Budgets Outside KBID

	2005							2006						
	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-2601	MF-2601 Required	MF-2601 Actual	MF-2601 Required	MF-2601 Actual	MF-2161	MF-2161	MF-2601	MF-2601 Required	MF-2601 Actual	MF-2601 Required	MF-2601 Actual	MF-2161	MF-2161
Inches Water Applied	16	10.3	8.2	10.3	8.2	0	0	16	10.3	8.1	10.3	8.1	0	0
INCOME PER ACRE														
Yield per acre	175.0	178.6	169.0	171.8	163.0	104.0	98.0	175.0	178.6	168.5	171.8	162.6	104.0	98.0
Price per bushel	2.32	2.07	2.07	2.07	2.07	2.32	2.07	2.71	3.08	3.08	3.08	3.08	2.71	3.08
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	406.00	369.73	349.81	355.59	337.44	241.28	202.86	474.25	550.12	519.06	529.09	500.84	281.84	301.84
SPENDING ON PRODUCED INPUTS														
Seed	54.00	54.00	54.00	54.00	54.00	43.20	43.20	57.30	57.30	57.30	57.30	57.30	45.84	45.84
Herbicide	29.66	29.66	29.66	29.66	29.66	29.66	29.66	30.80	30.80	30.80	30.80	30.80	30.80	30.80
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	77.50	79.17	74.73	76.02	71.97	44.40	41.66	73.11	74.67	70.31	71.72	67.76	42.11	39.54
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	22.75	23.22	21.97	22.33	21.19	13.52	12.74	22.75	23.22	21.91	22.33	21.14	13.52	12.74
Machinery Fuel and Oil	n/a	10.82	10.50	10.59	10.30	n/a	8.18	n/a	11.29	10.95	11.06	10.75	n/a	8.58
Machinery Repairs and Maintenance	n/a	16.96	16.46	16.60	16.15	n/a	12.83	n/a	17.71	17.17	17.34	16.85	n/a	13.46
Irrigation Fuel and Oil	48.00	21.94	17.47	19.19	14.38	0.00	0.00	36.00	16.45	12.97	14.40	10.67	0.00	0.00
Irrigation Repairs and Maintenance	5.28	2.22	1.77	0.77	0.61	0.00	0.00	5.28	2.22	1.75	0.77	0.61	0.00	0.00
Water District Assessment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Spending on Produced Inputs $/acre		237.98	226.55	229.16	218.26		148.27		233.66	223.16	225.72	215.87		150.96
Total Value Added $/acre		131.75	123.26	126.43	119.18		54.59		316.46	295.90	303.37	284.97		150.88

Sources: KSU crop budgets and tables 16, 17, 35 and 37

Table 39: Kansas Milo Crop Budgets Outside KBID

	2005							2006						
	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-2600	MF-2600 Required	MF-2600 Actual	MF-2600 Required	MF-2600 Actual	MF-2159	MF-2159	MF-2600	MF-2600 Required	MF-2600 Actual	MF-2600 Required	MF-2600 Actual	MF-2159	MF-2159
Inches Water Applied	14	10.3	8.2	10.3	8.2	0	0	14	10.3	8.1	10.3	8.1	0	0
INCOME PER ACRE														
Yield per acre	105.0	134.0	133.8	133.6	131.8	97.0	102.0	105.0	134.0	133.7	133.6	131.7	97.0	102.0
Price per bushel	2.25	1.70	1.70	1.70	1.70	2.25	1.70	2.63	3.37	3.37	3.37	3.37	2.63	3.37
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	236.25	227.80	227.45	227.14	224.05	218.25	173.40	276.15	451.58	450.66	450.27	443.78	255.11	343.74
SPENDING ON PRODUCED INPUTS														
Seed	17.70	17.70	17.70	17.70	17.70	11.80	11.80	16.38	16.38	16.38	16.38	16.38	10.92	10.92
Herbicide	27.28	40.32	40.22	40.14	39.32	27.28	28.83	27.41	41.41	41.27	41.22	40.29	27.41	29.07
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	44.93	58.93	58.83	58.74	57.86	41.21	43.50	42.70	55.85	55.73	55.68	54.80	39.20	41.35
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	13.65	17.42	17.39	17.37	17.13	12.61	13.26	13.65	17.42	17.38	17.37	17.12	12.61	13.26
Machinery Fuel and Oil	n/a	9.55	9.55	9.54	9.48	n/a	8.47	n/a	9.98	9.97	9.97	9.90	n/a	8.84
Machinery Repairs and Maintenance	n/a	14.98	14.97	14.96	14.86	n/a	13.28	n/a	15.65	15.64	15.63	15.52	n/a	13.86
Irrigation Fuel and Oil	42.00	21.94	17.47	19.19	14.38	0.00	0.00	31.50	16.45	12.97	14.40	10.67	0.00	0.00
Irrigation Repairs and Maintenance	4.62	2.22	1.77	0.77	0.61	0.00	0.00	4.62	2.22	1.75	0.77	0.61	0.00	0.00
Water District Assessment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Spending on Produced Inputs $/acre		183.05	177.90	178.41	171.34		119.13		175.36	171.10	171.41	165.29		117.30
Total Value Added $/acre		44.75	49.55	48.73	52.70		54.27		276.22	279.56	278.86	278.48		226.44

Sources: KSU crop budgets and tables 16, 17, 35 and 37

Table 40: Kansas Soybean Crop Budgets Outside KBID

	2005							2006						
	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated	KSU Base Budget	Center Pivot System	Center Pivot System	Furrow System	Furrow System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-2602	MF-2602 Required	MF-2602 Actual	MF-2602 Required	MF-2602 Actual	MF-2160	MF-2160	MF-2602	MF-2602 Required	MF-2602 Actual	MF-2602 Required	MF-2602 Actual	MF-2160	MF-2160
Inches Water Applied	16	10.3	8.2	10.3	8.2	0	0	16	10.3	8.1	10.3	8.1	0	0
INCOME PER ACRE														
Yield per acre	55.0	63.0	61.9	62.1	60.6	36.0	43.0	55.0	63.0	61.9	62.1	60.5	36.0	43.0
Price per bushel	5.66	5.45	5.45	5.45	5.45	5.66	5.45	5.71	6.37	6.37	6.37	6.37	5.71	6.37
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	311.30	343.35	337.57	338.54	330.12	203.76	234.35	314.05	401.31	394.05	395.69	385.34	205.56	273.91
SPENDING ON PRODUCED INPUTS														
Seed	44.10	44.10	44.10	44.10	44.10	44.10	44.10	46.20	46.20	46.20	46.20	46.20	44.10	44.10
Herbicide	11.20	11.20	11.20	11.20	11.20	11.20	11.20	10.34	10.34	10.34	10.34	10.34	10.34	10.34
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer and Lime	17.25	19.03	18.79	18.83	18.49	13.00	14.54	17.69	19.53	19.27	19.33	18.95	13.29	14.89
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery Fuel and Oil	n/a	7.09	7.06	7.06	7.01	n/a	6.37	n/a	7.46	7.42	7.43	7.37	n/a	6.71
Machinery Repairs and Maintenance	n/a	11.12	11.06	11.07	10.99	n/a	9.99	n/a	11.69	11.63	11.64	11.56	n/a	10.51
Irrigation Fuel and Oil	48.00	21.94	17.47	19.19	14.38	0.00	0.00	36.00	16.45	12.97	14.40	10.67	0.00	0.00
Irrigation Repairs and Maintenance	5.28	2.22	1.77	0.77	0.61	0.00	0.00	5.28	2.22	1.75	0.77	0.61	0.00	0.00
Water District Assessment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Spending on Produced Inputs $/acre		116.70	111.46	112.23	106.78		86.21		113.89	109.58	110.10	105.70		86.55
Total Value Added $/acre		226.65	226.11	226.31	223.34		148.14		287.42	284.46	285.58	279.64		187.36

Sources: KSU crop budgets and tables 16, 17, 35 and 37

Table 41: Kansas Alfalfa Hay Crop Budgets Outside KBID

	2005 KSU Base Budget	Center Pivot System	Center Pivot System	KSU Base Budget	Non Irrigated	2006 KSU Base Budget	Center Pivot System	Center Pivot System	KSU Base Budget	Non Irrigated
Base Kansas Crop Budget	MF-584	MF-584 Required	MF-584 Actual	MF-363	MF-363	MF-584	MF-584 Required	MF-584 Actual	MF-363	MF-363
Inches Water Applied	24	10.3	8.2	0	0	24	10.3	8.1	0	0
INCOME PER ACRE										
Yield per acre	7.5	5.6	5.3	4.0	3.9	7.5	5.6	5.3	4.0	3.9
Price per bushel	71.00	75.00	75.00	71.00	75.00	101.00	113.00	113.00	101.00	113.00
Indemnity payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Returns	532.50	420.40	399.01	284.00	292.50	757.50	633.40	599.82	404.00	440.70
Expenses per Planted Acre										
Seed	11.13	11.13	11.13	11.13	11.13	10.17	10.17	10.17	10.17	10.17
Herbicide	16.04	16.04	16.04	2.98	2.98	16.20	16.20	16.20	2.51	2.51
Insecticide/Fungicide	8.60	8.60	8.60	6.69	6.69	9.06	9.06	9.06	7.08	7.08
Fertilizer and Lime	31.25	23.00	21.76	31.83	30.53	32.38	23.84	22.50	33.88	32.48
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery Fuel and Oil	n/a	17.62	17.10	n/a	13.46	n/a	19.32	18.71	n/a	14.74
Machinery Repairs and Maintenance	n/a	27.62	26.82	n/a	21.11	n/a	30.28	29.34	n/a	23.10
Irrigation Fuel and Oil	162.00	21.94	17.47	0.00	0.00	122.16	16.45	12.97	0.00	0.00
Irrigation Repairs and Maintenance	7.92	2.22	1.77	0.00	0.00	7.92	2.22	1.75	0.00	0.00
Water District Assessment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Spending on Produced Inputs $/acre		128.17	120.69		85.90		127.54	120.70		90.08
Total Value Added $/acre		292.23	278.31		206.60		505.86	479.12		350.62

Sources: KSU crop budgets and tables 16, 17, 35 and 37

Table 42: Effects Outside KBID in 2005

Crops Actually Grown	Actual Water Crops							Dryland Crops				Dry/
	Corn		Milo		Soybeans			Corn	Milo	Soybeans	Alfalfa	Actual
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot					Total
Acres by crop	2,870		327		1,750		383					
Acres by crop & System	1,374	1,496	157	170	838	912	383	218	330	293	84	6,256
Gross Returns	349.81	337.44	227.45	224.05	337.57	330.12	399.01	202.86	173.40	234.35	292.50	1,990,939
Expenses per Planted Acre												
Seed	54.00	54.00	17.70	17.70	44.10	44.10	11.13	43.20	11.80	44.10	11.13	269,377
Herbicide	29.66	29.66	40.22	39.32	11.20	11.20	16.04	29.66	28.83	11.20	2.98	143,403
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	8.60	0.00	0.00	0.00	6.69	3,862
Fertilizer and Lime	74.73	71.97	58.83	57.86	18.79	18.49	21.76	41.66	43.50	14.54	30.53	300,667
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Drying	21.97	21.19	17.39	17.13	0.00	0.00	0.00	12.74	13.26	0.00	0.00	74,695
Machinery Fuel and Oil	10.50	10.30	9.55	9.48	7.06	7.01	17.10	8.18	8.47	6.37	13.46	59,392
Machinery Repairs and Maintenance	16.46	16.15	14.97	14.86	11.06	10.99	26.82	12.83	13.28	9.99	21.11	93,115
Irrigation Fuel and Oil	17.47	14.38	17.47	14.38	17.47	14.38	17.47	0.00	0.00	0.00	0.00	85,150
Irrigation Repairs and Maintenance	1.77	0.61	1.77	0.61	1.77	0.61	1.77	0.00	0.00	0.00	0.00	6,442
Water District Assessment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Spending on Produced Inputs $/acre	226.55	218.26	177.90	171.34	111.46	106.78	120.69	148.27	119.13	86.21	85.90	
Value Added $/acre	123.26	119.18	49.55	52.70	226.11	223.34	278.31	54.59	54.27	148.14	206.60	
Total Spending on Produced Inputs	311,257	326,521	27,849	29,208	93,357	97,393	46,275	32,394	39,368	25,236	7,244	1,036,103
Total Value Added	169,339	178,303	7,757	8,984	189,391	203,705	106,707	11,927	17,933	43,365	17,423	954,836

Crops That Should Have been Grown	Required Water Crops							Required Water	Dry/Actual Total	Difference from Water
	Corn		Milo		Soybeans				(from above)	Shortage
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot	Total		
Acres by crop	3,474		78		2,318		386			
Acres by crop & System	1,663	1,811	37	41	1,110	1,209	386	6,256	6,256	
Gross Returns	369.73	355.59	227.80	227.14	343.35	338.54	420.40	2,228,953	1,990,939	238,014
Expenses per Planted Acre										
Seed	54.00	54.00	17.70	17.70	44.10	44.10	11.13	295,495	269,377	26,119
Herbicide	29.66	29.66	40.32	40.14	11.20	11.20	16.04	138,318	143,403	-5,085
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	8.60	3,321	3,862	-540
Fertilizer and Lime	79.17	76.02	58.93	58.74	19.03	18.83	23.00	326,631	300,667	25,963
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Drying	23.22	22.33	17.42	17.37	0.00	0.00	0.00	80,403	74,695	5,708
Machinery Fuel and Oil	10.82	10.59	9.55	9.54	7.09	7.06	17.62	61,118	59,392	1,726
Machinery Repairs and Maintenance	16.96	16.60	14.98	14.96	11.12	11.07	27.62	95,820	93,115	2,705
Irrigation Fuel and Oil	21.94	19.19	21.94	19.19	21.94	19.19	21.94	128,844	85,150	43,694
Irrigation Repairs and Maintenance	2.22	0.77	2.22	0.77	2.22	0.77	2.22	9,443	6,442	3,001
Water District Assessment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Spending on Produced Inputs $/acre	237.98	229.16	183.05	178.41	116.70	112.23	128.17			
Value Added $/acre	131.75	126.43	44.75	48.73	226.65	226.31	292.23			
Total Spending on Produced Inputs	395,742	414,971	6,812	7,229	129,513	135,633	49,495	1,139,394	1,036,103	103,291
Total Value Added	219,094	228,931	1,665	1,975	251,545	273,492	112,856	1,089,559	954,836	134,723

Sources: Tables 36 and 38 through 41

Table 43: Effects Outside KBID in 2006

Crops Actually Grown	Actual Water Crops							Dryland Crops				Dry/ Actual
	Corn		Milo		Soybeans							
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot	Corn	Milo	Soybeans	Alfalfa	Total
Acres by crop	2,226		66		2,088		446					
Acres by crop & System	1,066	1,160	32	34	1,000	1,089	446	282	389	579	180	6,256
Gross Returns	519.06	500.84	450.66	443.78	394.05	385.34	599.82	301.84	343.74	273.91	440.70	2,701,302
Expenses per Planted Acre												
Seed	57.30	57.30	16.38	16.38	46.20	46.20	10.17	45.84	10.92	44.10	10.17	274,180
Herbicide	30.80	30.80	41.27	40.29	10.34	10.34	16.20	30.80	29.07	10.34	2.51	126,488
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	9.06	0.00	0.00	0.00	7.08	5,314
Fertilizer and Lime	70.31	67.76	55.73	54.80	19.27	18.95	22.50	39.54	41.35	14.89	32.48	248,817
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Drying	21.91	21.14	17.38	17.12	0.00	0.00	0.00	12.74	13.26	0.00	0.00	57,760
9. Machinery	92.79	91.08	84.52	83.90	62.87	62.46	158.57	72.73	74.94	56.83	124.89	
Machinery Fuel and Oil	10.95	10.75	9.97	9.90	7.42	7.37	18.71	8.58	8.84	6.71	14.74	60,970
Machinery Repairs and Maintenance	17.17	16.85	15.64	15.52	11.63	11.56	29.34	13.46	13.86	10.51	23.10	95,589
Irrigation Fuel and Oil	12.97	10.67	12.97	10.67	12.97	10.67	12.97	0.00	0.00	0.00	0.00	57,363
Irrigation Repairs and Maintenance	1.75	0.61	1.75	0.61	1.75	0.61	1.75	0.00	0.00	0.00	0.00	5,833
Water District Assessment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Spending on Produced Inputs $/acre	223.16	215.87	171.10	165.29	109.58	105.70	120.70	150.96	117.30	86.55	90.08	
Value Added $/acre	295.90	284.97	279.56	278.48	284.46	279.64	479.12	150.88	226.44	187.36	350.62	
Total Spending on Produced Inputs	237,794	250,482	5,409	5,690	109,556	115,070	53,793	42,556	45,610	50,119	16,234	932,313
Total Value Added	315,302	330,655	8,838	9,587	284,394	304,425	213,532	42,534	88,041	108,495	63,184	1,768,989

Crops That Should Have been Grown	Required Water Crops							Required Water	Dry/Actual Total (from above)	Difference from Water Shortage
	Corn		Milo		Soy					
	Pivot	Furrow	Pivot	Furrow	Pivot	Furrow	Pivot	Total		
Acres by crop	3,474		78		2,318		386			
Acres by crop & System	1,663	1,811	37	41	1,110	1,209	386	6,256	6,256	
Gross Returns	550.12	529.09	451.58	450.27	401.31	395.69	633.40	3,076,135	2,701,302	374,833
Expenses per Planted Acre										
Seed	57.30	57.30	16.38	16.38	46.20	46.20	10.17	311,354	274,180	37,174
Herbicide	30.80	30.80	41.41	41.22	10.34	10.34	16.20	140,430	126,488	13,942
Insecticide/Fungicide	0.00	0.00	0.00	0.00	0.00	0.00	9.06	3,499	5,314	-1,815
Fertilizer and Lime	74.67	71.72	55.85	55.68	19.53	19.33	23.84	312,619	248,817	63,802
Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Drying	23.22	22.33	17.42	17.37	0.00	0.00	0.00	80,403	57,760	22,644
Machinery Fuel and Oil	11.29	11.06	9.98	9.97	7.46	7.43	19.32	64,296	60,970	3,326
Machinery Repairs and Maintenance	17.71	17.34	15.65	15.63	11.69	11.64	30.28	100,803	95,589	5,214
Irrigation Fuel and Oil	16.45	14.40	16.45	14.40	16.45	14.40	16.45	96,633	57,363	39,270
Irrigation Repairs and Maintenance	2.22	0.77	2.22	0.77	2.22	0.77	2.22	9,443	5,833	3,610
Water District Assessment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Spending on Produced Inputs $/acre	233.66	225.72	175.36	171.41	113.89	110.10	127.54			
Value Added $/acre	316.46	303.37	276.22	278.86	287.42	285.58	505.86			
Total Spending on Produced Inputs	388,564	408,728	6,526	6,945	126,402	133,062	49,253	1,119,480	932,313	187,167
Total Value Added	526,264	549,349	10,279	11,300	318,981	345,126	195,356	1,956,655	1,768,989	187,666

Sources: Tables 36 and 38 through 41

Table 44: Summary of Kansas On-Farm Direct Losses in 2005 & 2006

	Above Lovewell		Below Lovewell		Total KBID		Both	Outside KBID		Both	Kansas Totals		Both
	2,005	2,006	2,005	2,006	2,005	2,006	Years	2,005	2,006	Years	2,005	2,006	Years
Gross Returns	1,739,093	1,526,143	1,222,851	1,332,544	2,961,944	2,858,687	5,820,631	238,014	374,833	612,846	3,199,958	3,233,519	6,433,477
								0	0				
Expenses per Planted Acre								0	0				
Seed	265,382	190,715	85,383	112,608	350,765	303,323	654,088	26,119	37,174	63,293	376,884	340,498	717,381
Herbicide	56,680	48,295	-17,901	56,324	38,779	104,619	143,398	-5,085	13,942	8,857	33,694	118,561	152,255
Insecticide/Fungicide	183	-3,762	-2,327	-7,074	-2,145	-10,836	-12,981	-540	-1,815	-2,355	-2,685	-12,651	-15,336
Fertilizer and Lime	283,167	208,552	153,782	246,536	436,949	455,088	892,038	25,963	63,802	89,766	462,913	518,891	981,803
Crop Insurance	-63,676	-56,490	-10,789	-22,229	-74,464	-78,719	-153,183	0	0	0	-74,464	-78,719	-153,183
Drying	83,181	68,985	35,318	87,860	118,499	156,845	275,344	5,708	22,644	28,352	124,208	179,489	303,696
Machinery Fuel and Oil	20,695	12,405	10,677	11,374	31,372	23,780	55,151	1,726	3,326	5,051	33,097	27,105	60,203
Machinery Repairs and Maintenance	32,445	19,449	16,740	17,832	49,185	37,281	86,466	2,705	5,214	7,919	51,890	42,496	94,386
Irrigation Fuel and Oil	258,530	160,556	251,040	175,257	509,569	335,813	845,382	43,694	39,270	82,963	553,263	375,082	928,345
Irrigation Repairs and Maintenance	19,256	15,705	17,708	16,090	36,964	31,795	68,758	3,001	3,610	6,612	39,965	35,405	75,370
Water District Assessment	150,745	150,568	295,965	295,604	446,710	446,172	892,882	0	0	0	446,710	446,172	892,882
Total Spending on Produced Inputs	1,106,588	814,979	835,595	990,182	1,942,183	1,805,161	3,747,344	103,291	187,167	290,458	2,045,474	1,992,328	4,037,802
Total Value Added	632,505	711,164	387,256	342,362	1,019,761	1,053,526	2,073,287	134,723	187,666	322,389	1,154,484	1,241,191	2,395,675

Sources: Tables 42 and 43

Table 45: Kansas Losses in KBID Above Lovewell in 2005 (Part 1)

SPENDING ON PRODUCED INPUTS	Change in Value Added and Produced: Original	Change in Value Added and Produced: Mapped [1/]	Wholesale Trade Margins % [2/]	Whole-sale Margin	Producer Margin	Regional Purchase Coefficient [3/]	In-State Spending	IMPLAN Industry Code	IMPLAN Industry Name
Seed	265,382	265,382	16.8%	44,611	220,771	0.265940	58,712	2	Grain farming
Herbicide	56,680	56,680	25.3%	14,312	42,368	0.285365	12,090	159	Pesticide and other agricultural chemical man
Insecticide/Fungicide	183	183	25.3%	46	137	0.285365	39	159	Pesticide and other agricultural chemical man
Fertilizer and Lime	283,167	283,167	9.9%	28,062	255,105	0.276912	70,642	156	Nitrogenous fertilizer manufacturing
Crop Insurance	(63,676)	(63,676)	NA		(63,676)	0.558900	(35,588)	427	Insurance carriers
Drying	83,181	83,181	NA		83,181	0.685429	57,015	18	Agriculture and forestry support services
Machinery Fuel and Oil	20,695	20,695	5.7%	1,171	19,523	0.878709	17,155	142	Petroleum Refineries
Machinery Repairs and Maint	32,445	32,445	NA		32,445	0.617100	20,022	485	Commercial machinery repair and maintenance
Irrigation Fuel and Oil (Deisel)	258,530	68,872	5.7%	3,898	64,974	0.878709	57,093	142	Petroleum Refineries
Irrigation Electricity		58,972	NA		58,972	0.903600	53,287	30	Power generation and supply
Irrigation Natrual Gas		130,685	NA		130,685	0.939600	122,792	31	Natural gas distribution
Irrigation Repairs and Maint	19,256	19,256	NA		19,256	0.617100	11,883	485	Commercial machinery repair and maintenance
Water District Assessment	150,745	150,745	NA		150,745	1.000000	150,745	499	Other State and local government enterprises
Wholesale Trade		NA	NA	NA	92,100	0.858688	79,085	390	Wholesale trade
Intial Value Added	632,505	632,505	NA	NA	NA	NA	NA		Value Added
TOTALS	1,739,093	1,739,093		92,100	1,106,588		674,972		

Sources: From Table 44 except as noted below

[1/] spreadsheet file "IMPLAN source Kan.xls," worksheet "energy"

[2/] spreadsheet file "IMPLAN source Kan.xls," worksheet "margins"

[3/] spreadsheet file "IMPLAN source Kan.xls," worksheet "RPC Kan"

Table 46: Kansas Losses in KBID Above Lovewell in 2005 (Part 2)

IMPLAN Industry Code	IMPLAN Industry Name	In-State Spending	IMPLAN Value Added Multipliers [1/] Secondary Direct	Secondary Indirect	Secondary Induced	Value Added Effects: Detail and Summary On-Farm Direct	Secondary Direct	Secondary Indirect	Secondary Induced
2	Grain farming	58,712	0.4813510	0.1633819	0.1278983	-	28,261	9,592	7,509
159	Pesticide and other agricultural chemical man	12,090	0.2732899	0.2317943	0.0840858	-	3,304	2,803	1,017
159	Pesticide and other agricultural chemical man	39	0.2732899	0.2317943	0.0840858	-	11	9	3
156	Nitrogenous fertilizer manufacturing	70,642	0.2200546	0.2329606	0.0879652	-	15,545	16,457	6,214
427	Insurance carriers	(35,588)	0.3739453	0.2888479	0.1801156	-	(13,308)	(10,280)	(6,410)
18	Agriculture and forestry support services	57,015	0.7523088	0.0585072	0.4026177	-	42,893	3,336	22,955
142	Petroleum Refineries	17,155	0.1488994	0.2600717	0.0835002	-	2,554	4,462	1,432
485	Commercial machinery repair and maintenance	20,022	0.4717120	0.1402744	0.1697349	-	9,445	2,809	3,398
142	Petroleum Refineries	57,093	0.1488994	0.2600717	0.0835002	-	8,501	14,848	4,767
30	Power generation and supply	53,287	0.8128922	0.0539658	0.1103853	-	43,317	2,876	5,882
31	Natural gas distribution	122,792	0.2894060	0.2193933	0.1010844	-	35,537	26,940	12,412
485	Commercial machinery repair and maintenance	11,883	0.4717120	0.1402744	0.1697349	-	5,605	1,667	2,017
499	Other State and local government enterprises	150,745	0.3752436	0.2393597	0.1634026	-	56,566	36,082	24,632
390	Wholesale trade	79,085	0.6741940	0.1299438	0.2037021	-	53,319	10,277	16,110
	Value Added	NA	NA	NA	0.2942110	632,505			186,090
	TOTALS	674,972				632,505	291,549	121,877	288,030

Sources: Table 45, except as noted below

1/ spreadsheet file "IMPLAN source Kan 06.xls," worksheet "IMPLAN Kan"

Table 47: Kansas Total Losses, Nominal Dollars

Losses:	Losses in 2005 Above Lovewell	Below Lovewell	Outside KBID	Kansas 2005 Total	Losses in 2006 Above Lovewell	Below Lovewell	Outside KBID	Kansas 2006 Total
On-Farm Direct	632,505	387,256	134,723	1,154,484	711,164	342,362	187,666	1,241,191
Secondary Direct and Indirect	413,426	389,672	38,628	841,726	311,322	418,463	62,251	792,036
Subtotal	1,045,931	776,928	173,351	1,996,210	1,022,486	760,825	249,917	2,033,227
Secondary Consumer Spending-Induced	288,030	208,176	48,137	544,343	288,557	210,826	71,660	571,043
Total	1,333,961	985,105	221,488	2,540,553	1,311,043	971,651	321,577	2,604,271

Source: Table 46 and other working tables on the electronic spreadsheet version of table 46/47

Table 48: Compounding Factors for Past Kansas Losses

	Rate for High Grade Municipals	Compounding Factors 2005	2006
2006	4.42	1.044	
2007	4.42	1.090	1.044
2008	4.8	1.143	1.094
2009	4.64	1.196	1.145
2010	4.18	1.246	1.193
2011			
Jan	5.02		
Feb	4.92		
Mar	4.7		
Apr	4.71		
May	4.34		
Jun	4.22		
Jul	4.24		
Aug	3.92		
Sep	3.79		
Oct 8th	3.86		
2011 Ave	4.372	1.300	1.245

Source: **Economic Indicators.jpg** Office of the President, Council of Economic Advisors, Economic Indicators, September 2011, page 30.

Table 49: Kansas Total Losses, January 1, 2012 Dollars

Losses:	Losses in 2005 Above Lovewell	Below Lovewell	Outside KBID	Kansas 2005 Total	Losses in 2006 Above Lovewell	Below Lovewell	Outside KBID	Kansas 2006 Total	Total Kansas Losses
On-Farm Direct	822,354	503,492	175,160	1,501,007	885,484	426,282	233,666	1,545,432	3,046,438
Secondary Direct and Indirect	537,517	506,634	50,223	1,094,374	387,633	521,036	77,510	986,179	2,080,553
Subtotal	1,359,871	1,010,126	225,383	2,595,381	1,273,117	947,318	311,176	2,531,611	5,126,992 *
Secondary Consumer Spending-Induced	374,483	270,661	62,585	707,729	375,169	274,106	93,169	742,444	1,450,174
Total	1,734,354	1,280,788	287,968	3,303,110	1,648,285	1,221,424	404,346	3,274,055	6,577,165

* This is the portion of Kansas total losses that should be paid by Nebraska to make Kansas whole.

Sources: Tables 47 and 48