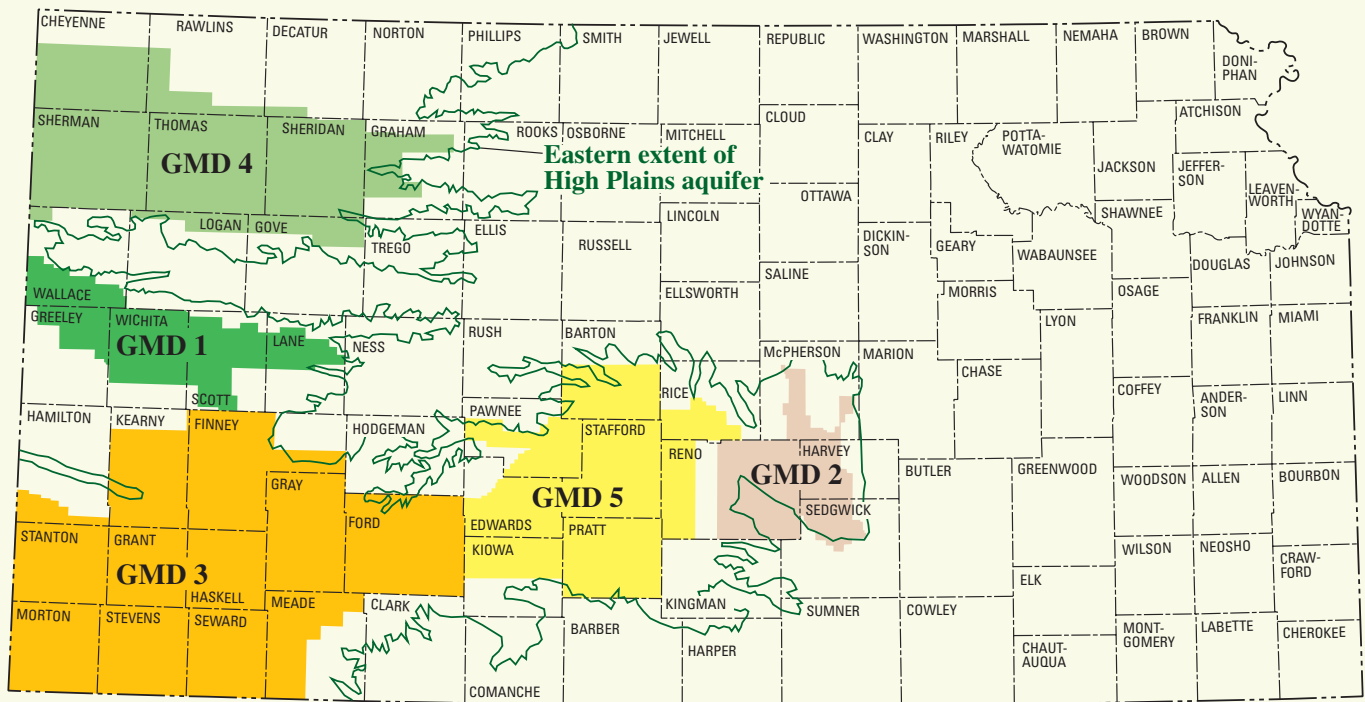


Prepared in cooperation with the
KANSAS WATER OFFICE

Effects of Irrigation Practices on Water Use in the Groundwater Management Districts Within the Kansas High Plains, 1991–2003



Scientific Investigations Report 2006–5069

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By Charles A. Perry

Prepared in cooperation with the Kansas Water Office

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**U.S. Department of the Interior
U.S. Geological Survey**

U.S. Department of the Interior
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Conversion Factors, Abbreviations, and Datum

Multiply	By	To obtain
Length		
inch (in.)	2.54	centimeter (cm)
mile (mi)	1.609	kilometer (km)
Area		
acre	4,047	square meter (m ²)
acre	0.4047	hectare (ha)
acre	0.4047	square hectometer (hm ²)
acre	0.004047	square kilometer (km ²)
acre per year (acre/yr)	4,047	square meter per year (m ² /yr)
Volume		
acre-foot (acre-ft)	1,233	cubic meter (m ³)
acre-foot (acre-ft)	0.001233	cubic hectometer (hm ³)
Rate		
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year (m ³ /yr)
acre-foot per acre (acre-ft/acre)	0.3048	cubic meter per square meter (m ³ /m ²)
inch per hour (in/h)	2.54	centimeter per hour (cm/hr)

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Effect of Irrigation Practices on Water Use in the Groundwater Management Districts Within the Kansas High Plains, 1991–2003

By Charles A. Perry

Abstract

Data compiled for the High Plains region of Kansas that includes five Groundwater Management Districts (GMDs) were analyzed for trends in irrigation water use, acres irrigated, precipitation, irrigation system types, and irrigated crop types to determine the effects of irrigation practices on water use over time. For the study period 1991 through 2003, precipitation decreased significantly (with 95-percent confidence) in northwestern and west-central Kansas but not in the southwestern and south-central parts of the State. Irrigation water use had no statistically significant trend during this period. There was a good ($R = -0.77$) relation between average regional precipitation and total GMD irrigation water use. When irrigation water use was adjusted for this relation, there was a positive trend (90-percent confidence level) in the adjusted irrigation water use. Another adjustment to water use was made using the ratio of annual precipitation to 1991–2005 average precipitation, which resulted in a negative trend (95-percent confidence level) in irrigation water use. This demonstrated the contradictory nature of precipitation adjustments to water use, making their utility somewhat suspect. GMD 3 in southwestern Kansas used 63 percent of the total acre-feet of irrigation water within all the GMDs.

When all GMDs are considered, the number of irrigated acres for flood and center pivot systems without drop nozzles decreased significantly during the study period. At the same time the number of drop nozzle irrigated acres increased significantly. The number of irrigated acres of water-intensive crops (corn, alfalfa, and soybeans) also increased significantly, whereas the number of less- or non-water-intensive crops (grain sorghum and wheat), and multiple crop type acres decreased. Drop nozzle irrigation systems used approximately 2 percent less water in a year-by-year comparison than center pivot systems and 8 to 11 percent less water than flood irrigation.

The best estimator of irrigation water use incorporated total acres irrigated and annual average or March–October regional precipitation. A conclusion that can be drawn from the trend analyses described in this report is that, although irrigation water use for all GMDs showed no statistically significant

trend, an apparent increased efficiency of center pivots irrigation systems with drop nozzles has allowed more water-intensive crops to be grown on more irrigated acres.

Introduction

Background

The High Plains aquifer underlies parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming (fig. 1). Approximately 90 percent of the total water used for irrigation in Kansas in 2003 was pumped from wells in counties underlain by the High Plains aquifer. Historically, the saturated thickness of the High Plains aquifer has been declining in Kansas since the 1940s (McGuire and Sharpe, 1997). These declines have been mitigated somewhat by implementing various conservation strategies such as local regulation, changes in irrigation management practices, and significant advances to improve the efficiency of irrigation systems (McGuire and Sharpe, 1997).

In an effort to reduce consumptive use of ground water in western Kansas, State government has promoted various programs such as cost sharing for more efficient irrigation systems, assistance with irrigation scheduling, and preparation of conservation plans. These efforts have been ongoing for more than 10 years, during which time State and Federal agencies have invested substantially in equipment cost sharing and technical assistance to irrigators. Cost sharing is implemented locally through the county conservation districts. In State fiscal year 2003, Kansas conservation districts eligible for irrigation initiative allocations received approximately \$388,000 to implement irrigation efficiency practices (Kansas State Conservation Commission, 2005).

Five Groundwater Management Districts (GMDs) were created in the 1970s in the western and south-central parts of the State. GMDs provide water-use administration, planning, and information. The districts are governed by local boards and have been instrumental in providing information and identifying research and regulatory needs within their boundaries.

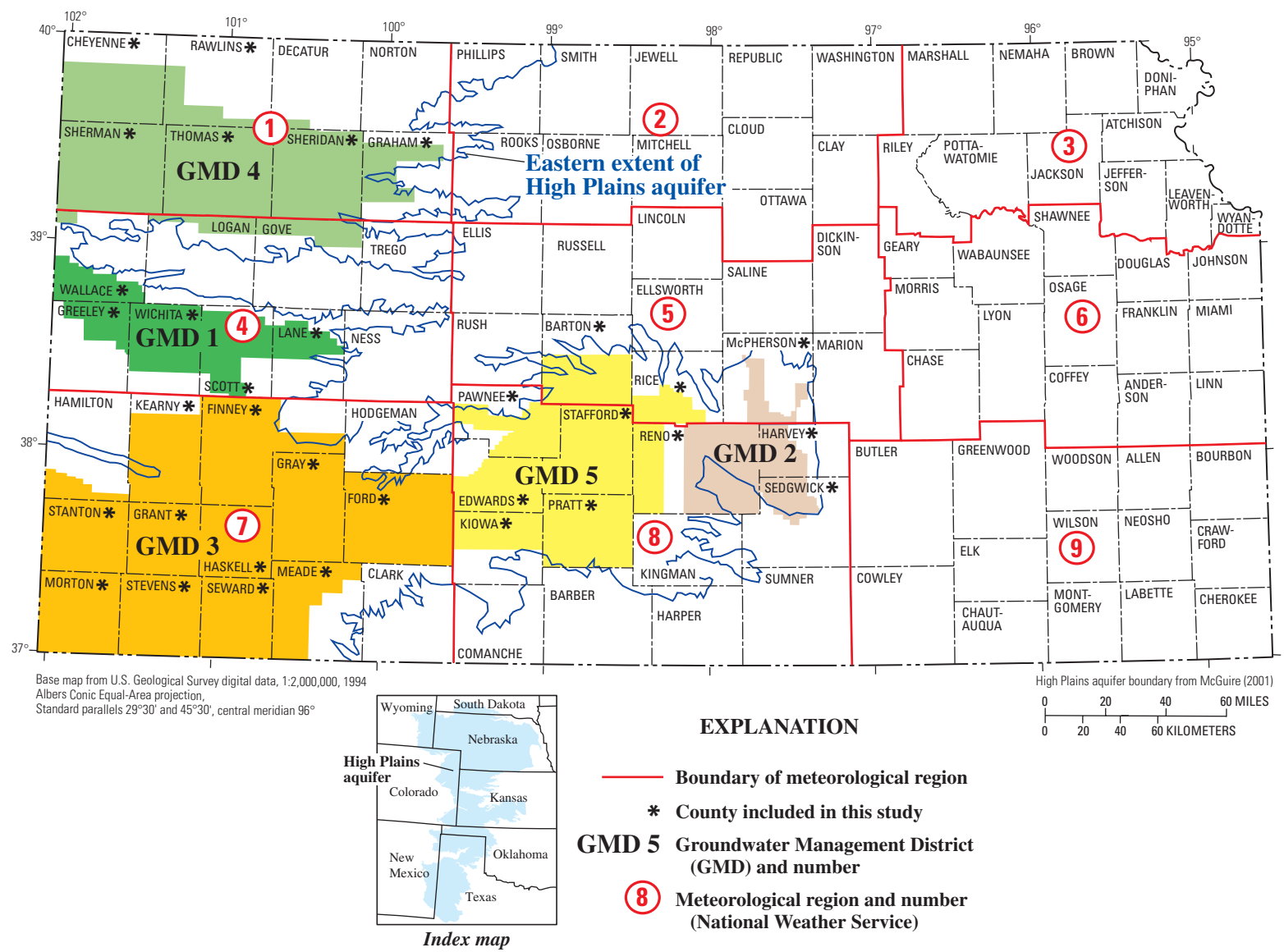


Figure 1. Location of High Plains aquifer, counties included in study, Groundwater Management Districts, and meteorological regions in Kansas.

There is substantial interest from State water agencies, GMDs, and irrigators in evaluating the effectiveness of the cost-sharing investments in actually reducing consumptive irrigation water use. There is anecdotal evidence in some areas of the State that improved irrigation system efficiency has led to a net increase in water use as a result of either increases in the number of acres irrigated, increases in the length of the irrigation season by growing multiple crops, or irrigating crops with greater water requirements. This 1-year study by the U.S. Geological Survey (USGS), done in cooperation with the Kansas Water Office, was conducted to determine the effect of more efficient irrigation systems on irrigation water use in areas underlain by the High Plains aquifer in Kansas.

There are many factors that affect irrigation water use including precipitation, temperature, wind, number of acres irrigated, soil permeability, crop types, crop application rates, length of irrigation season, and irrigation system type. The question of whether water use has decreased or not as a result of the addition of cost-shared drop nozzles to center pivot irrigation systems needed to be addressed.

Purpose and Scope

The purpose of this report is to describe changes in irrigation water use during the past 13 years (1991–2003) in areas of Kansas in proximity of the High Plains aquifer and to evaluate the effect of more efficient irrigation systems on water use. Relations between irrigation water use and changes in precipitation, acreage, crop type, and system type are described using existing county data. Irrigation water use data in this report primarily but not exclusively represent withdrawals from the High Plains aquifer.

The study area was limited to 33 counties, of which at least one-third or more of the county lies within one of the five GMDs (fig. 1). Reported water-use data from 1991 to 2003 (Kansas Water Office and Kansas Department of Agriculture, 1993–2005), including acre-feet applied, acres irrigated, crop type, and irrigation system type, along with the climatic variable precipitation were analyzed statistically. Site-specific data reported by irrigators each year to the Kansas Department of Agriculture, Division of Water Resources, and aggregated by county were used in this investigation to indicate any significant changes over time in Kansas irrigation water use, the geographic distribution of any such changes, and whether these changes in water use may be related to irrigation practices. The 1991 start year was chosen because that was the first year the State collected data on irrigation system type. Summaries of county irrigation withdrawals by method of reporting, acres irrigated by crop type, and acres irrigated by system type were prepared for each year from 1991 through 2003. These data were used to develop annual county-level estimates for irrigation water use, number of acres irrigated and acre-foot per acre application rates, using flood, center pivot with and without drop nozzles, or other systems, and number of acres planted to alfalfa, corn, grain sorghum, soybeans, wheat, and multiple

crop types. Additional data considered in this investigation included precipitation from weather stations monitored by the U.S. Weather Service throughout western and south-central Kansas.

Statistical analyses of the data were conducted with simple procedures such as trend analyses and multiple least-squares regression to identify significant variables that affect irrigation water use. Statistical relations between irrigation water use and precipitation, crop types, and irrigation system type were evaluated and interpreted. County and GMD tables showing changes in irrigation water use and percentage of drop nozzle systems were generated and compared (see tables 1–19 in section on “Data Tables” at the back of this report).

The scope of this report did not include computing actual consumptive water use. Consumptive water use is difficult to measure even on a highly instrumented individual test site. Efficient irrigation systems reduce both evaporation and deep percolation. The rate of deep percolation of applied water returning to the aquifer can only be estimated. However, if the assumption that a certain percentage of applied water finds its way back to the water table under nonefficient irrigation systems, a lesser percentage of water would return to the aquifer under more efficient irrigation systems. More efficient systems would imply that less water would return to the aquifer.

Data Compilation

Precipitation Data

Precipitation data used in this study have been collected by the National Oceanic and Atmospheric Administration (1895–2004) since 1895. Average monthly values for 1895–2004 for the nine meteorological regions in Kansas (fig. 1) were compiled by the National Oceanic and Atmospheric Administration’s National Climatic Center in Asheville, North Carolina. These precipitation data also have been aggregated into average monthly values for each county in Kansas and are available through the Kansas State University Weather Data Library (<http://www.oznet.ksu.edu/wdl/>) for the period 1981 through 2004. Monthly precipitation values were used to compute a seasonal (March through October) precipitation total for each county for the time period 1991 through 2003 (table 1 at the back of this report).

Irrigation Data

Irrigation data for this study have been collected by the Kansas Department of Agriculture, Division of Water Resources, on an annual basis since 1989. Annual water-use reports are required of all irrigators in Kansas, and return rates of the reports to the Kansas Department of Agriculture are about 99 percent as a result of penalties for nonreporting (Statutory Authority: K.S.A. 82a–701 et seq., K.S.A. 82a–1501 through

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1508, as amended) (http://www.kwo.org/Reports%20&%20Publications/REDBOOK/kda_dwr.pdf). These data are published in annual reports (Kansas Water Office and Kansas Department of Agriculture, Division of Water Resources, 1993–2005). This data set has evolved as irrigation practices have changed. Center pivots with drop nozzle irrigation systems were incorporated into the data set beginning in 1992.

Information is reported by point of diversion and includes the amount of water pumped, acres irrigated, crop type, and irrigation system type. Follow-up letters and phone calls are made to obtain missing data and to confirm or correct anomalous data (for example, excessive application rates). Where water use from multiple points of diversion is reported with a single total for acres irrigated, the acres are prorated among the diversion points. Beginning with the 2001 irrigation data, there has been an increasing number of reports with missing data due to decreased follow-up efforts. The most common problems are missing acres, crop type, and system type.

Irrigation data used in this report were aggregated by county and by GMD. The water-use reports were coded both with county location and GMD number. If the location was outside of the GMD boundary, it still was included in its respective county. For each of the five GMDs and the 33 counties included in this study, water use and acres irrigated were summarized by major crop type and by system type. Acre-feet per acre application rates were calculated for irrigation water use and also for each major crop and system type within each county and GMD. A description of crop and system types is provided in the following paragraphs.

Water applied to acres of single crops was identified for five major crop types—alfalfa, corn, grain sorghum, soybeans, and wheat. Because it is common to irrigate multiple crop types with single points of diversion, the largest number of irrigated acres reported on the questionnaire was for other or multiple crops. By prorating the numbers of acres reported for specified combinations of major crop types, an estimate was made of total acres of the five major crop types irrigated. This prorating technique assigned acres to each specified crop type in equal percentages. For example, if multiple crops were listed and corn and wheat were specified, 50 percent of the acres were assigned to each crop. If three crops were specified, then each was assigned 33.3 percent of the acres.

The major categories of irrigation system type identified on the water-use reports were flood, drip, center pivot, center pivot with drop nozzles, sprinkler other than center pivot, and combinations. In 1991, no identification of center pivot systems with drop nozzles was made, and the sprinkler other than center pivot was used primarily for golf course irrigation. Since 1992, water use and acres irrigated have been reported in increasing numbers for center pivot systems with drop nozzles.

Soil Permeability Data

Soil permeability for each county in the study area was estimated from soil permeability data for Kansas

(U.S. Department of Agriculture, 1994) (fig. 2). Permeability estimates were made for three randomly selected basins within each county that was underlain by the High Plains aquifer. Sub-basins were those available from the Kansas stream statistics Web page (<http://ks.water.usgs.gov/Kansas/studies/strmstats/ks/?test=basin>). These three estimates were averaged to provide an estimate of the mean soil permeability for the county (table 1).

Data Sets

For this report, irrigation information was compiled into two sets of data. The first data set included irrigation data from 1991 through 2003 for each county having at least one-third of its area within a GMD (tables 1 and 2 at the back of this report). There were 33 counties that fell into this category (fig. 1). Data included irrigation water use, total acres irrigated, and irrigation application rates for system type (flood, center pivot, center pivot with drop nozzle, and other systems) and for crop type (alfalfa, corn, grain sorghum, soybeans, wheat, and other/multiple use). In addition to this irrigation information, average annual precipitation and an estimate of mean county soil permeability were included (table 1). The second set of data (tables 3 and 4 at the back of this report) included all irrigation information for each GMD. Soil permeability for each GMD was not determined. The average precipitation for each GMD was estimated as the average precipitation for their respective meteorological region (fig. 1) and is included in table 5 at the back of this report.

Effects of Irrigation Practices on Water Use

Statistical Analyses

Kendall's Tau trend analysis (Kendall and Gibbons, 1990) was used in this report to determine objectively if trends in water-use data exist. Kendall's Tau is a mathematical technique that compares each data point in a time series with the other data points and determines the degree to which the data values are increasing or decreasing. The method provides a measure of the probability (p) of the trend whether positive or negative. The user then can choose the degree of confidence of accepting the computed trend. In most cases, the user wants to be 95-percent confident that the trend is real. Therefore, p must be equal to or less than 0.05. For a less confident 90-percent level, p must be equal to or less than 0.10. If $p=0.01$, the confidence would be 99 percent. The slope provided by Kendall's Tau analysis is a measure of the rate (magnitude) of the trend—the greater the slope, the greater the magnitude of the trend. A positive slope indicates a positive trend, and a negative slope indicates a negative trend.

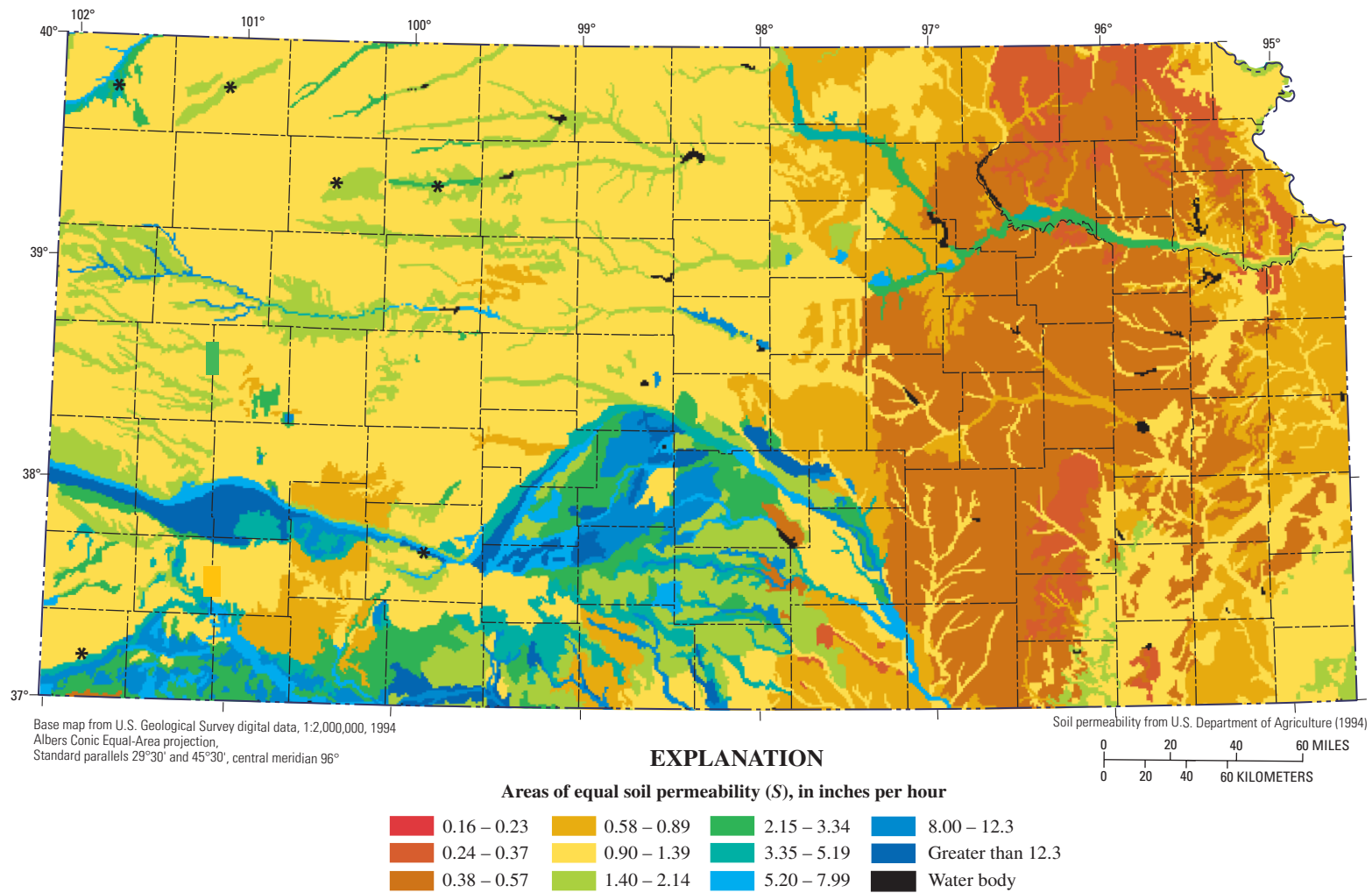


Figure 2. Soil permeability in Kansas.

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Linear regression was used to determine the relation between an independent variable such as precipitation and a dependent variable such as water use. From this analysis a correlation coefficient was computed, which indicated the degree of fit between the two variables. The correlation coefficient, R , can vary from $R=0$, which is no fit, to $R=+1.0$, a perfect positive correlation, or to $R=-1.0$, a perfect negative correlation. When the correlation coefficient is squared, the result provides a measure of the variability within the data. For example, a relation with $R=0.8$, would have 64 percent of the variability within the relation explained by the independent variable.

Precipitation Trends

In analyzing irrigation data for trends, the factor that seems most important is the amount of precipitation. Irrigation supplies water needed for plant growth that is not supplied by rainfall, and the annual or growing-season precipitation should be linked directly to the amount of water applied through irrigation.

On average for the counties in the study area, 87 percent of the annual precipitation occurs from March through October. The remainder occurs during the winter months November through February. However, precipitation during the winter is crucial for antecedent moisture conditions for spring planting and winter wheat growth. Therefore, annual precipitation values were used in most of the analyses described in this report.

Figure 3 shows the distribution of annual precipitation for four of the meteorological regions (1, 4, 7, and 8) in Kansas. Table 6 (at the back of this report) is a compilation of Kendall's trend analysis (Kendall and Gibbons, 1990) of various time intervals of annual regional precipitation. The intervals were 1895 to 2003, 1950 to 2003, 1970 to 2003, 1980 to 2003, and finally the period 1991 through 2003, which is the time interval that includes the irrigation data described in this report. To be significant at the 95-percent confidence interval, the p -value must be equal to or less than 0.05. For the first four periods, the only significant trend (positive) was during the period 1950 to 2003 in meteorological region 9 in southeastern Kansas (fig. 1). For 1991 through 2003, two regions had significant decreases in precipitation. Those decreases occurred in northwestern Kansas (region 1) and west-central Kansas (region 4). Average regional precipitation was defined as the average of the precipitation in meteorological regions 1, 4, 7, and 8. No statistically significant trend occurred in the average annual regional precipitation.

Irrigation Trends by Groundwater Management Districts

Total GMD irrigation water use for 1991 through 2003 was analyzed for trend, and it too did not show a significant trend. However, when average regional precipitation was

compared with total GMD irrigation water use (fig. 4), a fairly good relation existed. The correlation coefficient was $R=-0.77$, by which average annual regional precipitation explained 60 percent of the variability ($R^2=0.60$) of total GMD irrigation water use. The negative correlation indicates that more water was used during years with less precipitation.

A trend analysis for each of the GMDs was performed on precipitation, irrigation water use, acres irrigated, and irrigation application rate according to system type and crop type (tables 7–12). The rate of trend is reflected in the slope of the trend. The only significant trend (95-percent confidence level) in total irrigation water use was for GMD 2. The trend was positive and was slightly more than 6,000 acre-ft/yr (table 8). For total acres irrigated, all GMDs except GMD 1 had a statistically significant increase at the 95-percent confidence level (tables 8–11). However, the increase for GMD 3 (the largest) was only 99 acre/yr (table 9). GMD 5 had the largest significant increase in acres irrigated at 4,617 acre/yr (table 11), GMD 4 had an increase of 2,330 acre/yr, and GMD 2 had an increase of 2,843 acre/yr. The trend for total acres irrigated for all GMDs was a positive 8,311 acre/yr and was significant at the 90-percent level ($p=0.059$) (table 12). In every GMD the number of acres decreased significantly for flood and center pivot systems without drop nozzles and increased significantly for center pivot systems with drop nozzles (tables 7–12).

The total number of acre-feet used and number of acres irrigated, by system type and crop type, varied among GMDs because of their comparative sizes and geographic locations. Figure 5A–F shows the irrigation water use in thousands of acre-feet, figure 6A–F shows the number of acres irrigated for each system type, and figure 7A–F shows the number of acres irrigated for each crop type. GMD 3 had the largest amount of irrigation water use and the most acres irrigated of any of the GMDs—63 percent of the total GMD water use and 57 percent of the total acres. For the number of acres irrigated by system type, the graphs in figure 6 show the decrease in acres irrigated using flood and center pivot systems and the concurrent increase in acres irrigated by center pivot systems with drop nozzles. This trend is apparent in each GMD (tables 7–12). GMD 3 had the largest number of acres converted to drop nozzle irrigation, approximately 800,000. The number of acres planted to corn (after other or multiple crops were pruned) was the largest for any crops for all GMDs (fig. 7).

Trends in irrigation water use and number of acres irrigated for each crop suggested that more water-intensive crops are being irrigated simultaneously with the trend toward more acres irrigated by center pivots with drop nozzles. During 1991–2003, irrigation water use and acres irrigated increased significantly (at the 95-percent confidence level) for alfalfa, corn, and soybeans (table 12). Concurrently, the less water-intensive crops of grain sorghum and wheat had significant (at the 95-percent confidence level) negative trends in number of acres irrigated. A conclusion that can be drawn from these analyses is that, although total irrigation water use for all GMDs showed no statistically significant trend, an apparent increased efficiency

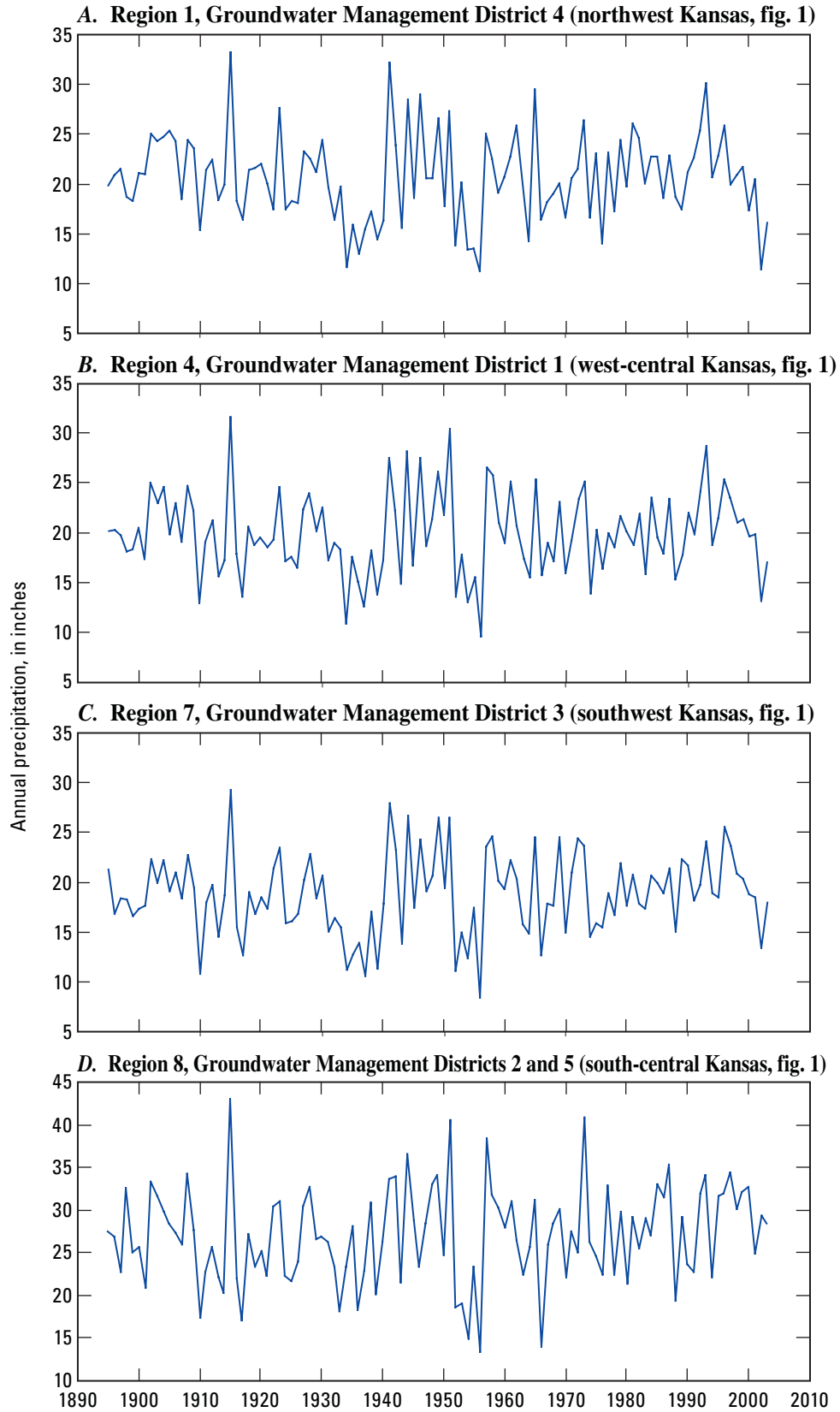


Figure 3. Annual precipitation by meteorological region, 1895–2003 (data from National Oceanic and Atmospheric Administration, 1895–2005).

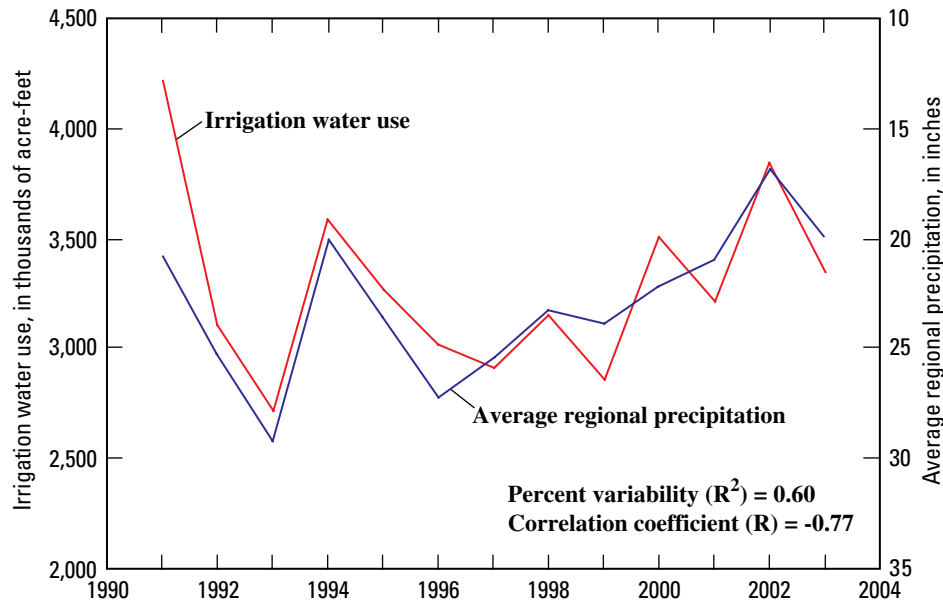


Figure 4. Relation between irrigation water use for Groundwater Management Districts and average precipitation for meteorological regions 1, 4, 7, 8, 1991–2003 (water-use data from Kansas Water Office and Kansas Department of Agriculture, Division of Water Resources, 1993–2005, and precipitation data from National Oceanic and Atmospheric and Administration, 1895–2005).

of center pivot irrigation systems with drop nozzles has allowed more water-intensive crops to be grown on more irrigated acres.

Irrigation Trends by County

Kendall's Tau analyses were performed on county data for irrigation water use and total acres irrigated. Trend analyses also were performed on annual county precipitation for comparison. These results are listed in table 1. The largest significant positive trends at the 95-percent confidence level for either irrigation water use or total acres irrigated occurred in Harvey, Pratt, Reno, Seward, Sherman, and Stevens Counties. The largest significant negative trends at the 95-percent confidence level for either irrigation water use or total acres occurred in Grant, Haskell, and Stanton Counties.

Effect of Precipitation on Irrigation Water Use

As noted in the section on "Precipitation Trends," irrigation water use has a general link to precipitation. To test this relation in more detail, average annual county precipitation was compared to irrigation water use for each county for each year from 1991 through 2003. Individual county analyses showed a range of correlation coefficients from a high of $R=0.91$ for Pawnee County to a low of $R=0.07$ for Reno County (table 13). The average correlation coefficient for all 33 counties was $R=0.58$.

Irrigation application rate did not correlate with precipitation amounts (average correlation coefficient of 0.12).

When irrigation water use in each GMD was considered with its respective regional precipitation, GMD 4 had the best relation, with 68 percent of the variability ($R^2=0.68$) explained using annual precipitation from region 1 precipitation (table 14). Sixty percent of the irrigation water use for all of the GMDs was explained by the average regional precipitation (average of regions 1, 4, 7, and 8). When this relation was examined on a year-to-year basis (fig. 8), the data generally fell into a pattern of 1991 through 1996 data (center pivots with drop nozzles less than 10 percent of total acres irrigated, from table 3) plotting above the line of regression, while data from 1997 through 2003, except 2000 (center pivots with drop nozzles greater than 28 to 60 percent of total acres irrigated), plotting below the line of regression. If the data are separated into two data sets, the resulting regression lines show a decrease in irrigation water use with respect to precipitation from approximately 400,000 acre-ft at 20 in. of precipitation to 300,000 acre-ft at 25 in. of precipitation for all GMDs. The difference between the y-intercepts for the two regression lines was found to be statistically significant using the statistical t test.

Because the shortage of precipitation necessitates the application of irrigation water, two equations were developed to factor in the effect of precipitation variability on collective irrigation water use for all GMDs. These equations were generated to explore the effect of annual precipitation on the amount of irrigation water use. A regression equation was developed to estimate adjusted water use from the relation between average

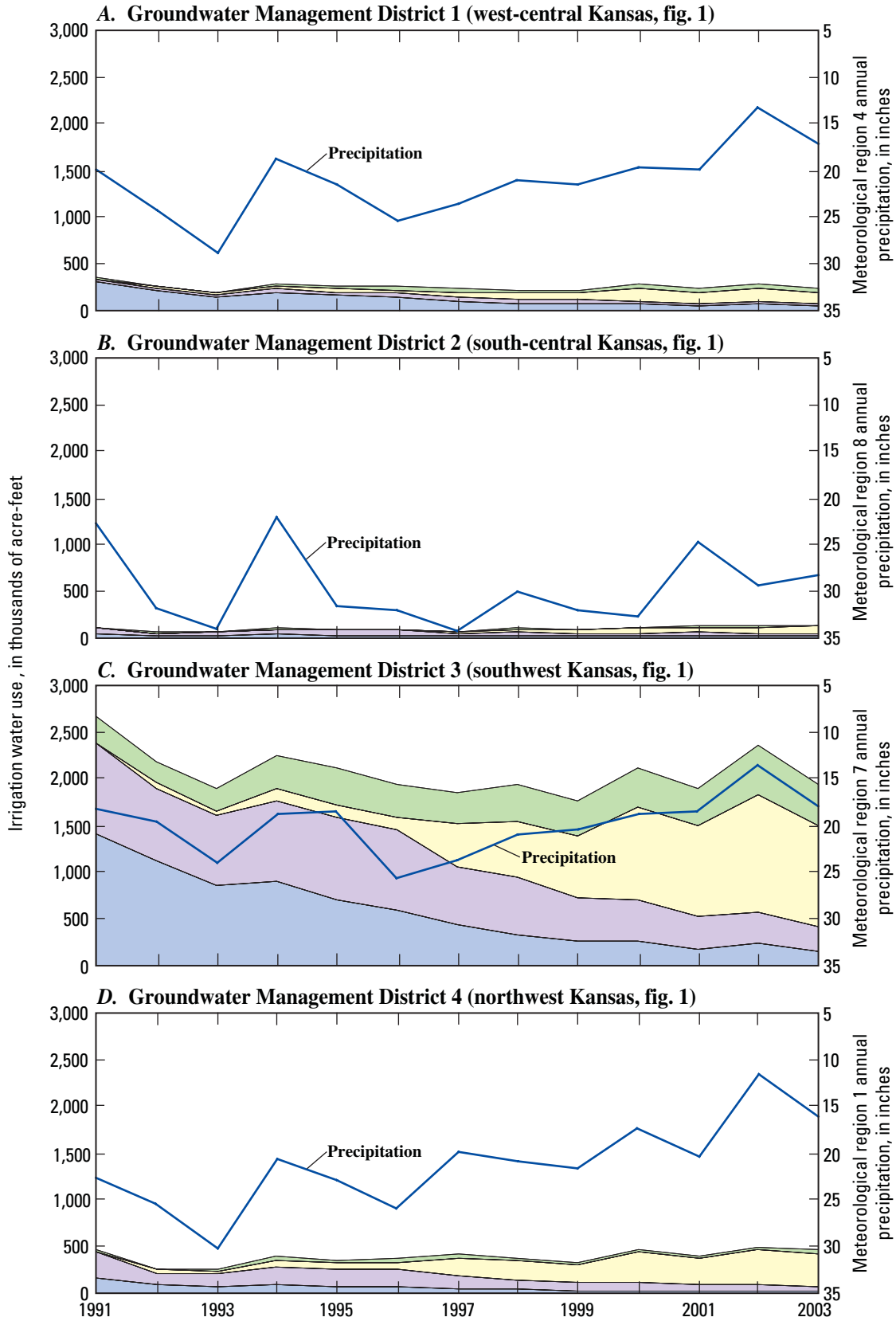


Figure 5. Irrigation water use and annual regional precipitation by Groundwater Management District, 1991–2003 (water-use data from Kansas Water Office and Kansas Department of Agriculture, Division of Water Resources, 1993–2005, and precipitation data from National Oceanic and Atmospheric Administration, 1895–2005).

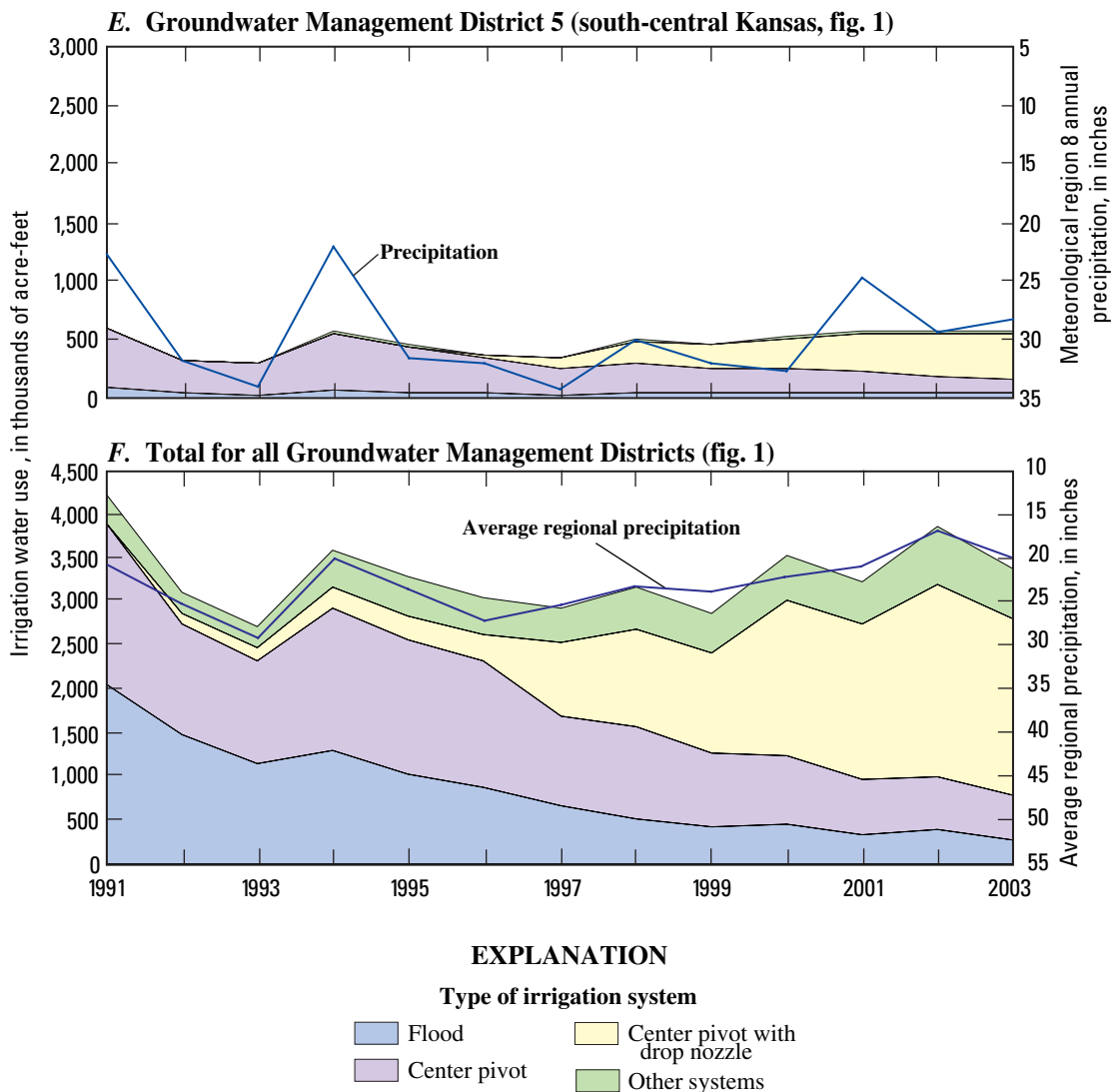


Figure 5. Irrigation water use and annual regional precipitation by Groundwater Management District, 1991–2003 (water-use data from Kansas Water Office and Kansas Department of Agriculture, Division of Water Resources, 1993–2005, and precipitation data from National Oceanic and Atmospheric Administration, 1895–2005).—Continued

annual precipitation for the four meteorological regions in the study area and the measured irrigation water use. The equation becomes:

$$\text{Estimated water use (acre-feet)} = 96,300 \times (\text{average regional precipitation, inches}) + 5,500,000. \quad (1)$$

The second equation used to adjust irrigation water use for the variability of precipitation consisted of multiplying each annual water use times the ratio of the 13-year precipitation average to the annual precipitation:

$$\text{Estimated water use} = \text{Annual water use} \times \frac{(\text{Average regional precipitation})}{\text{Annual regional precipitation}}. \quad (2)$$

As noted in a preceding section, the measured irrigation water use had no statistically significant trend during the 13-year study period. The regression-equation estimate (equation 1) showed a positive trend in water used that had a p-value of 0.076 (that is, significant at the 90-percent level). The estimate of water use using the ratio of average to annual regional precipitation (equation 2) resulted in a statistically significant (at the 95-percent confidence level) negative trend in water use (fig. 9). The trend analyses of the results from the comparison of two methods of adjusting irrigation water use for precipitation were contradictory. This demonstrates the problem of adjusting irrigation water use for precipitation where both equations are valid.

The average total water received for each year for all the irrigated area within the GMDs was estimated from the average

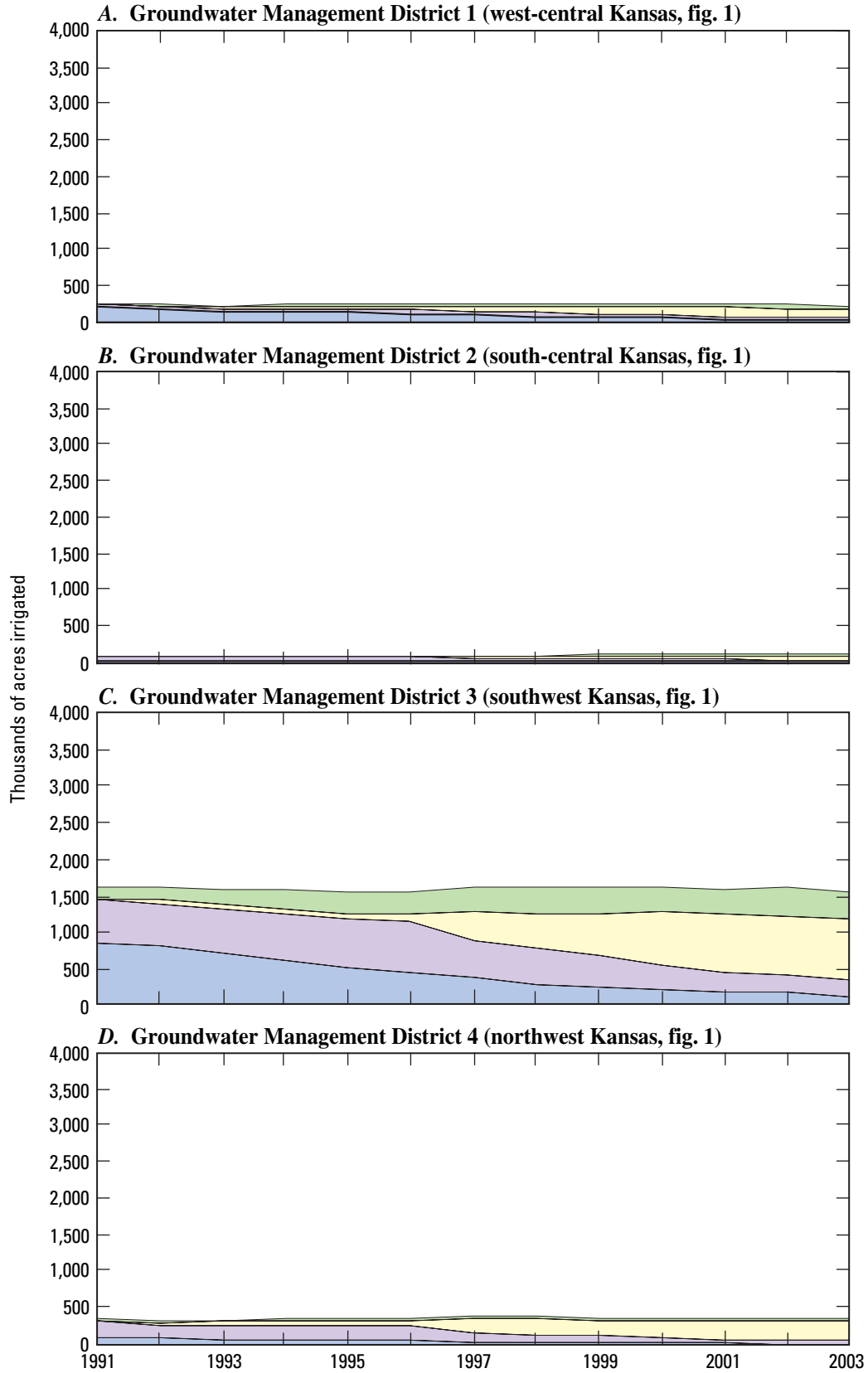


Figure 6. Acres irrigated by system type for Groundwater Management Districts, 1991–2003 (data from Kansas Water Office and Kansas Department of Agriculture, Division of Water Resources, 1993–2005).

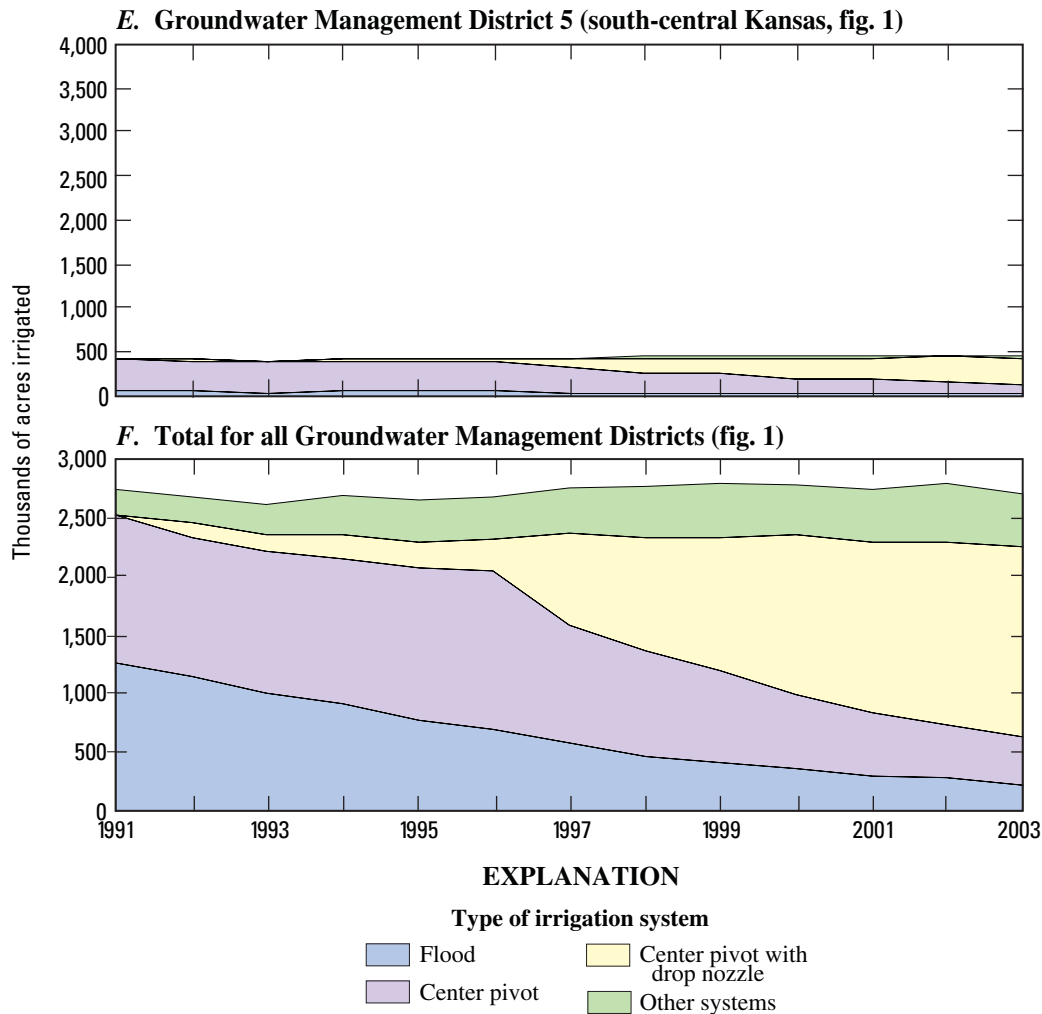


Figure 6. Acres irrigated by system type for Groundwater Management Districts, 1991–2003 (data from Kansas Water Office and Kansas Department of Agriculture, Division of Water Resources, 1993–2005).—Continued

precipitation over the study area plus the average irrigation application rate. Irrigation water use in acre-feet was divided by the number of acres irrigated for each year to obtain the average irrigation application rate. This number was converted to inches and added to the average precipitation for the study area. The results are listed in table 16 and shown in figure 10. The graph shows that the total water applied has decreased from 1991 to 2003. Kendall’s Tau analysis on this time series shows a statistically significant decrease ($p=0.003$) with a Kendall’s slope of -0.46 in/yr. Linear regression on this data results in a slope of -0.48 in/yr and an $R^2=0.60$.

Effect of Drop Nozzles on Irrigation Water Use

One method of analyzing the effect of drop nozzle irrigation systems on irrigation water use is to compare irrigation

application rates for each year. From the information in table 3, graphs comparing flood and center pivot application rates to center pivots with drop nozzle application rates were constructed for each GMD and for the combination of all GMDs. A least-squares regression was performed on each data set, and the resulting relation was forced to a y-intercept of 0. The slope of the resulting line shows the percentage of water used by one irrigation system compared to the other. For the center-pivot to drop-nozzle comparison, slopes ranged from 0.98 to 1.05 (fig. 11A–E) for individual GMDs. When irrigation water use and total acres irrigated for each year were used to compute a total application rate, the slope was 0.98 (fig. 11F), indicating that the drop nozzle application rate used approximately 2 percent less water than the center pivot application rate. When flood irrigation was compared with the drop nozzle application

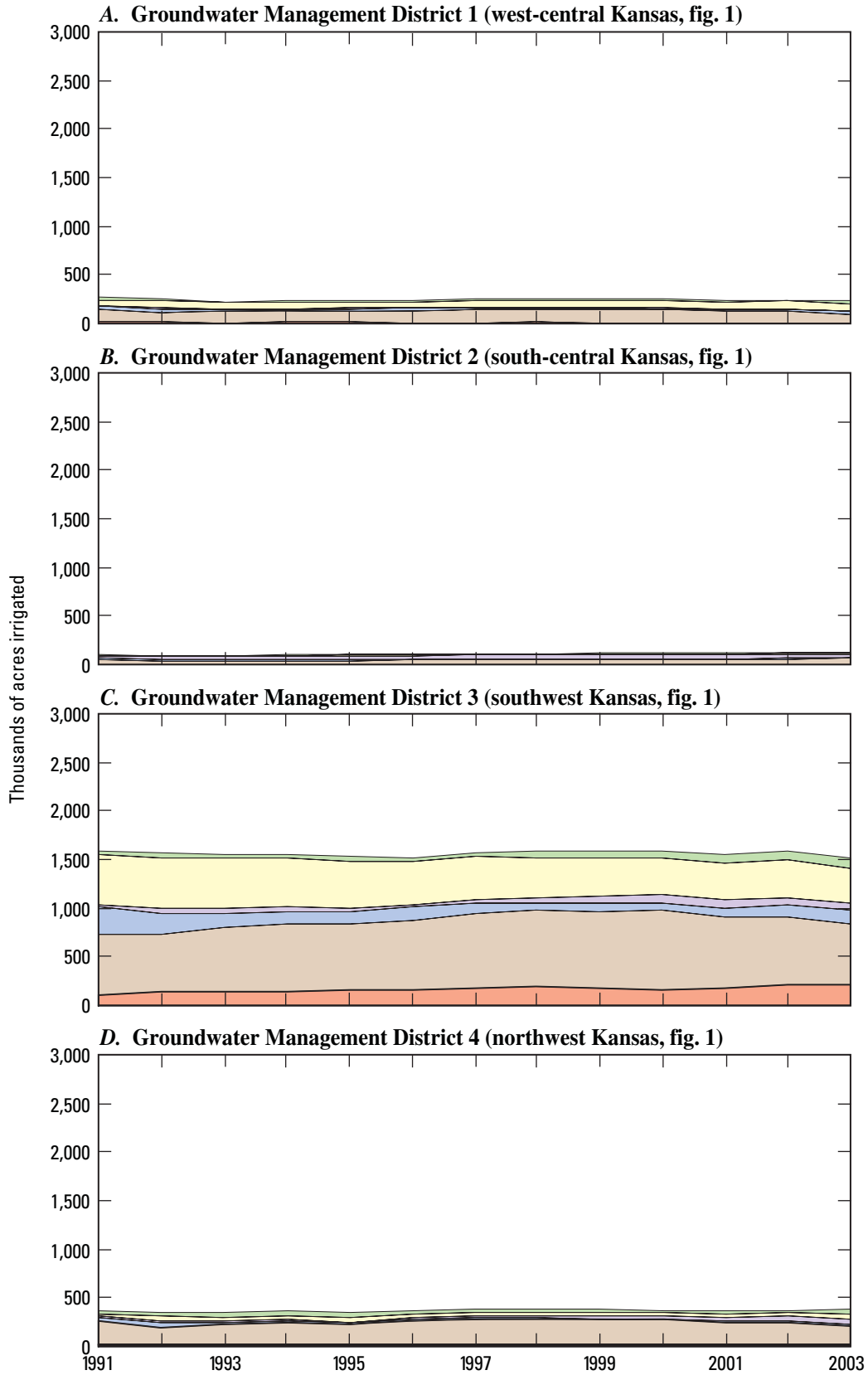


Figure 7. Acres irrigated by crop type for Groundwater Management Districts, 1991–2003 (data from Kansas Water Office and Kansas Department of Agriculture, Division of Water Resources, 1993–2005).

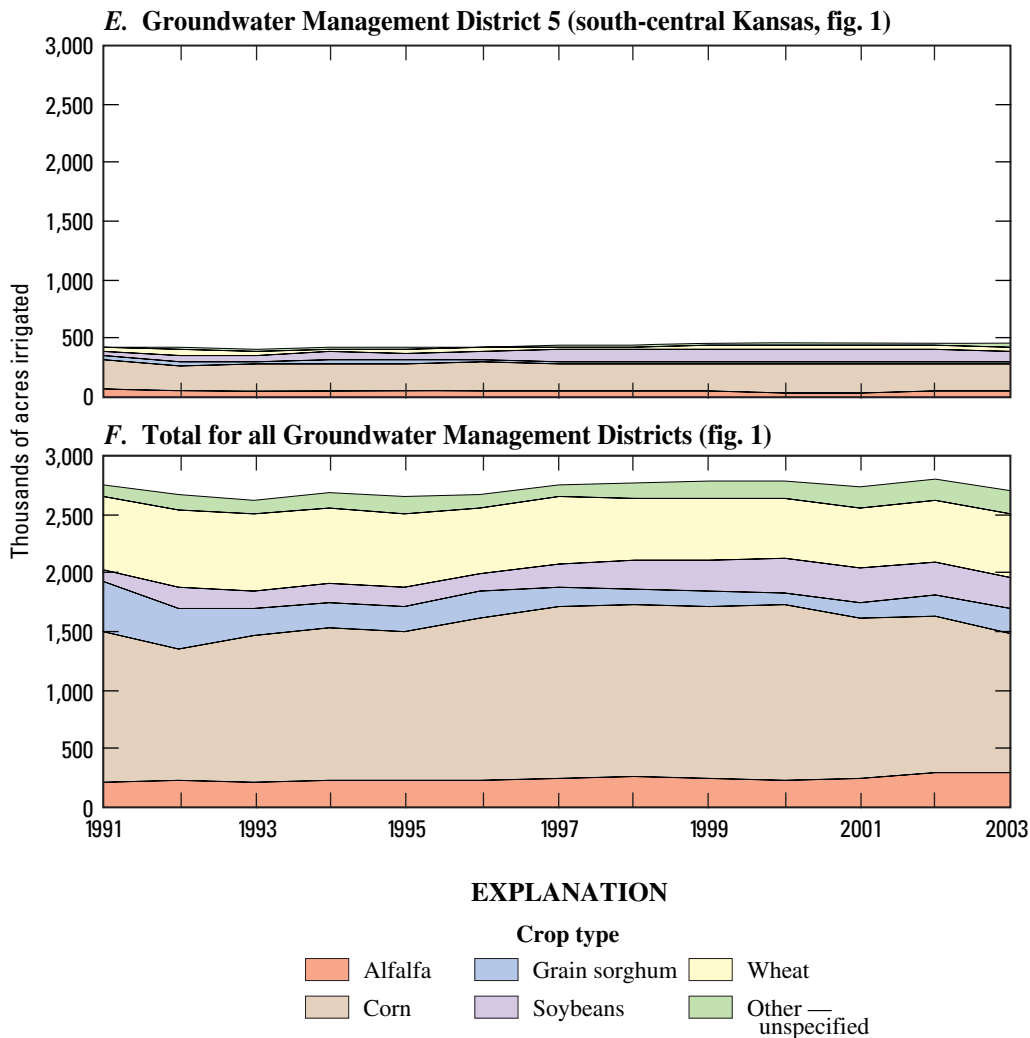


Figure 7. Acres irrigated by crop type for Groundwater Management Districts, 1991–2003 (data from Kansas Water Office and Kansas Department of Agriculture, Division of Water Resources, 1993–2005).—Continued

rate, the slope ranged from 0.82 to 1.10 (fig. 12A–F), and for the total application rate for all GMDs, the slope was 0.92 (fig. 12F). This analysis indicated that drop nozzle systems on average used 8 percent less water than flood irrigation systems. An analysis was done using the county data as well. Both GMD and county analyses are summarized in table 17 for the time period 1992–2003.

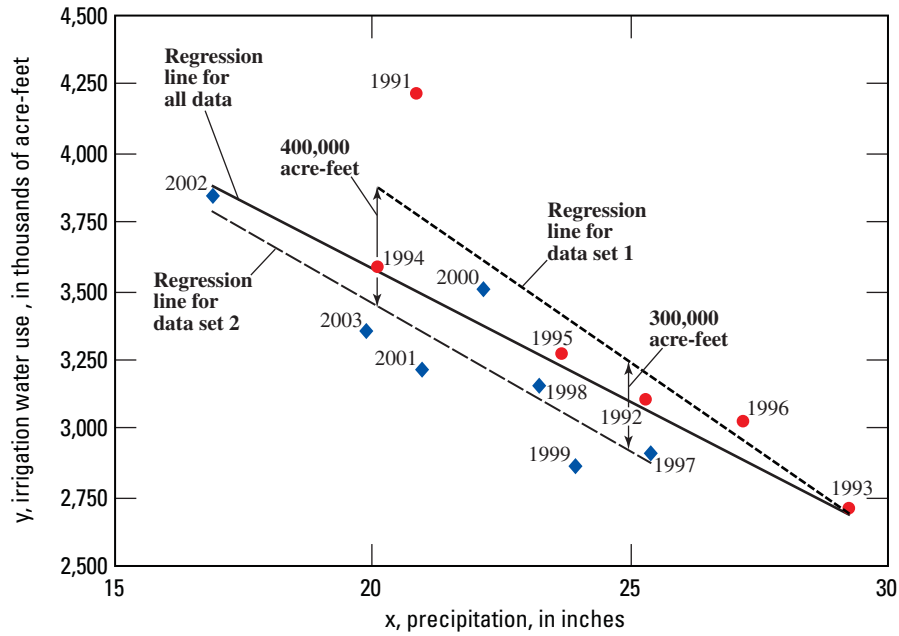
Effect of Crop Conversion on Irrigation Water Use

Total irrigated acres increased from 2,681,000 to 2,746,000 acres between 1991–93 and 2001–03, a 2.4-percent increase; however, during this time, the total acres of corn, alfalfa, and soybeans increased from 25 to 40 percent, depending upon whether total prorated acres (1,483,000 to 1,859,000 acres) or only the actual corn-alfalfa-soybean reported acres (828,000 to 1,167,000 acres) are used (table 12). Using either figure, there has been a substantial increase in

crops that traditionally are water intensive. When the average irrigation water use for the first 3 years (1991–93, 3,344,000 acre-ft) is compared with the last 3 years (2001–03, 3,470,000 acre-ft) (table 3), there has been a 3.8-percent increase in irrigation water use from one period to the next. This increase in the total number of acres and the number of acres with water-intensive crops probably would result in an increase in water use in excess of the actual increase were irrigation efficiency not increasing.

Correlation of Factors Affecting Irrigation Water Use

An attempt was made to correlate the factors that affect irrigation water use using data from tables 1 and 2. Table 18 is a correlation matrix from a stepwise multiple regression analysis for water-use factors for the 33-county data set. Correlation



EXPLANATION

- Data set 1 (1991–96)
- ◆ Data set 2 (1997–2003)

All data $y = -96,300x + 5,500,000$ $R^2 = 0.60$
 Data set 1 $y = -129,000x + 6,470,000$ $R^2 = 0.77$
 Data set 2 $y = -107,000x + 5,600,000$ $R^2 = 0.79$

Figure 8. Relation between irrigation water use and precipitation, 1991–2003.

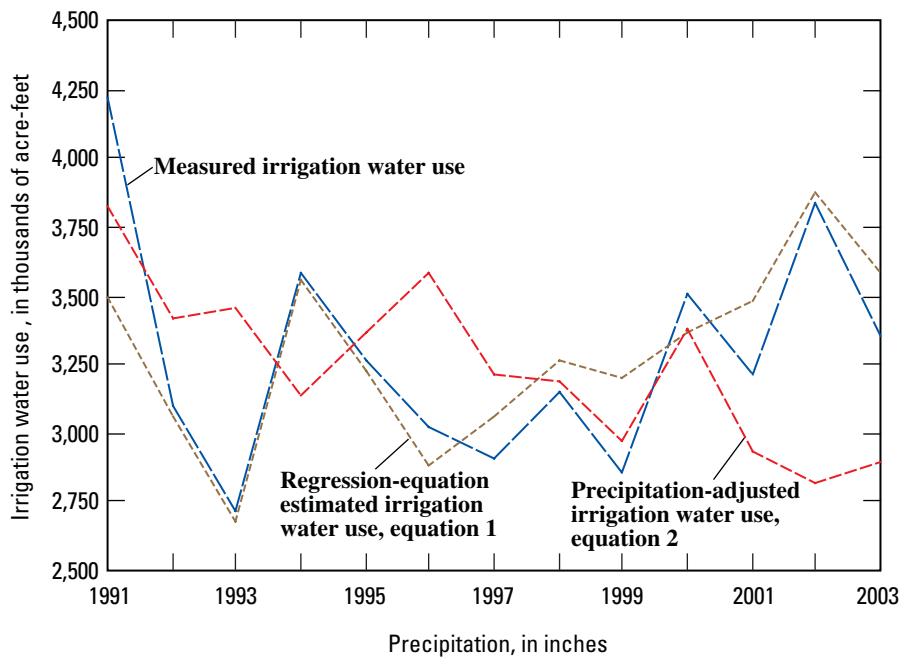


Figure 9. Comparison of measured irrigation water use and precipitation-adjusted irrigation water use for Groundwater Management Districts using two different equations for adjustment.

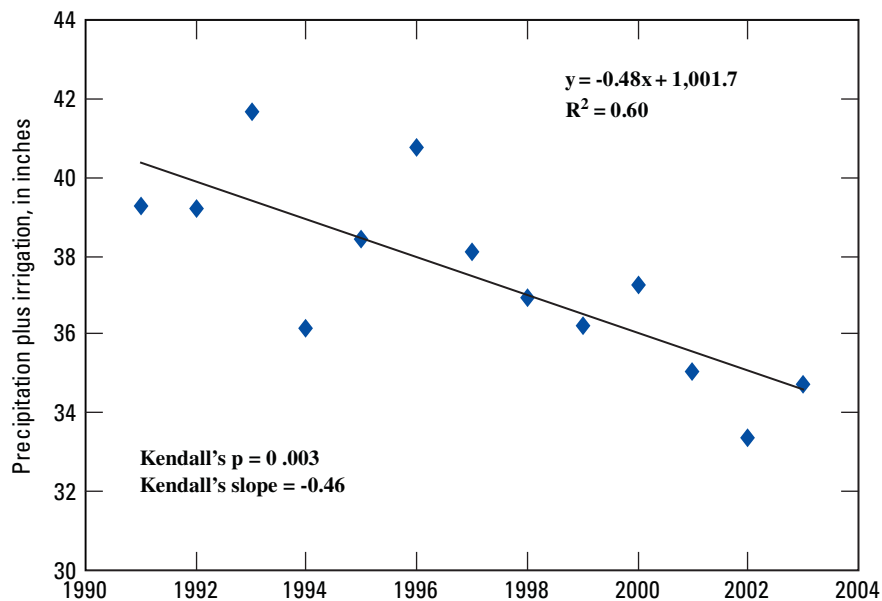


Figure 10. Average precipitation plus irrigation-applied water for all Groundwater Management Districts, 1991–2003.

coefficients ranged from $R=0.97$ to $R=-0.67$. The major factor in irrigation water use is the total number of acres irrigated ($R=0.97$). The next most significant factor was average annual county precipitation or March–October precipitation. The best estimate of irrigation water use involved the use of total number of acres irrigated and the average annual regional precipitation. Table 19 summarizes the multiple regression analyses for irrigation water use and for irrigation application rates for corn and alfalfa, the two most common crops grown in the Kansas High Plains GMDs.

Summary

Data compiled for the High Plains region of Kansas that includes five Groundwater Management Districts (GMDs) were analyzed for trends in precipitation, irrigation system types, and crop types to determine the effects of irrigation practices on water use. For the study period 1991 through 2003, precipitation decrease significantly at the 95-percent confidence level in northwestern and west-central Kansas, but there was no statistically significant increase or decrease in southwestern and south-central Kansas. When the precipitation from four meteorological regions was averaged, there was no statistically significant trend (at the 95-percent confidence level) in precipitation. There was a good ($R=-0.77$) relation between average regional precipitation and irrigation water use for all GMDs. Actual irri-

gation water use had no significant trend, but when adjusted for the ratio of the 1991–2003 average precipitation to yearly precipitation, there was a significant decrease in adjusted water use at the 95-percent confidence level. GMD 3 in southwestern Kansas used 63 percent of the total number of acre-feet of irrigation water and had 57 percent of the total acres irrigated within all of the GMDs.

The number of flood irrigation and center pivot irrigated acres decreased significantly during the study period. At the same time, the number of drop nozzle irrigated acres increased significantly. Irrigated acres of water-intensive corn, alfalfa, and soybeans also increased significantly, whereas irrigated acres of less water-intensive grain sorghum and wheat, and multiple crop type decreased significantly. Irrigation application rates for drop-nozzle irrigation systems averaged approximately 2 percent less than application rates for center pivot systems in a year-by-year comparison and were 8 to 11 percent less than application rates for flood irrigation systems. However, both were not statistically different from zero change.

The best estimator of irrigation water use incorporated total acres irrigated and average annual or March–October regional precipitation. A conclusion that can be drawn from these analyses is that, although irrigation water use for all GMDs showed no statistically significant trend, an apparent increased efficiency of center pivots irrigation systems with drop nozzles has allowed more water-intensive crops to be grown on more irrigated acres.

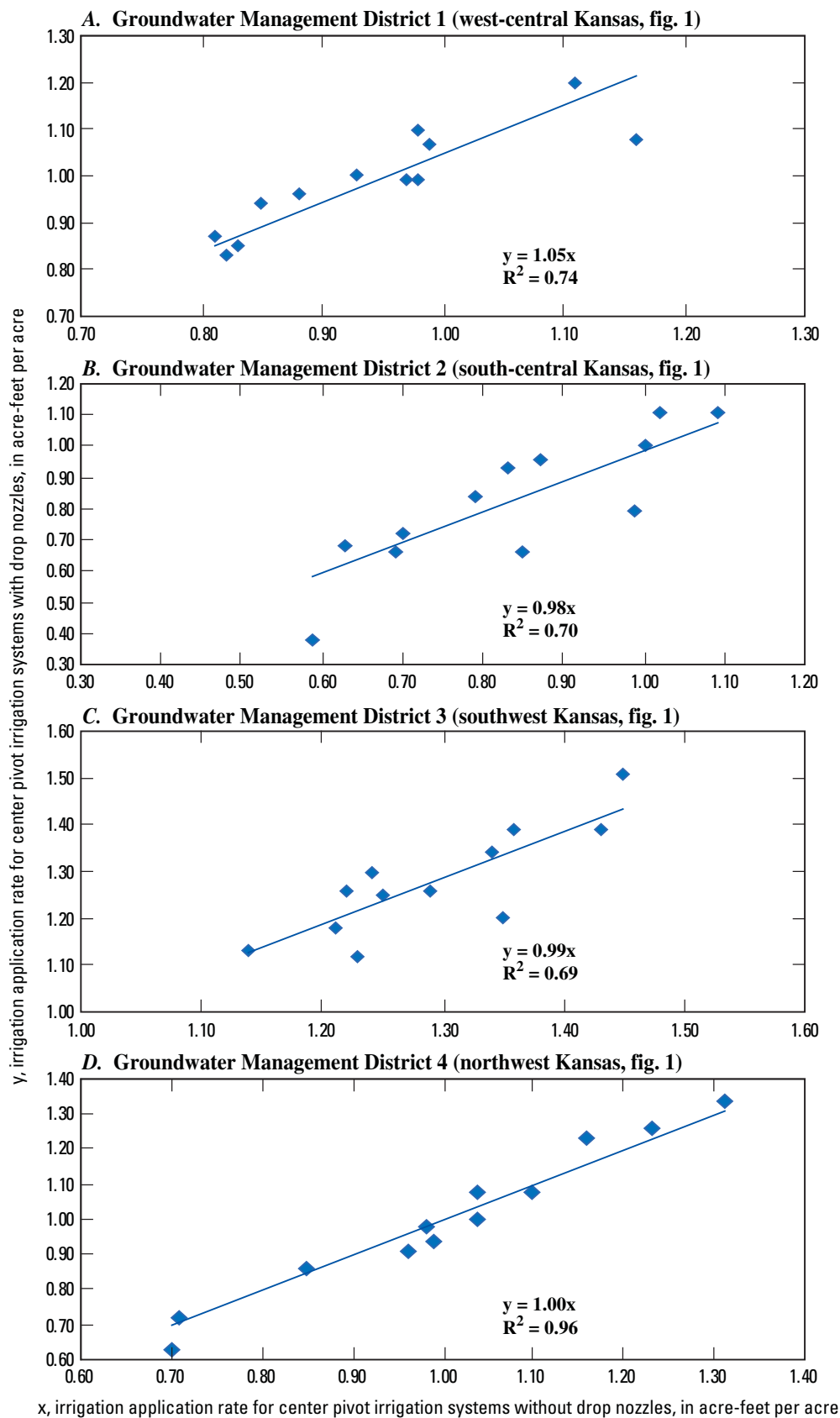


Figure 11. Relation between irrigation application rates for center pivot systems with and without drop nozzles for Groundwater Management Districts, 1992–2003.

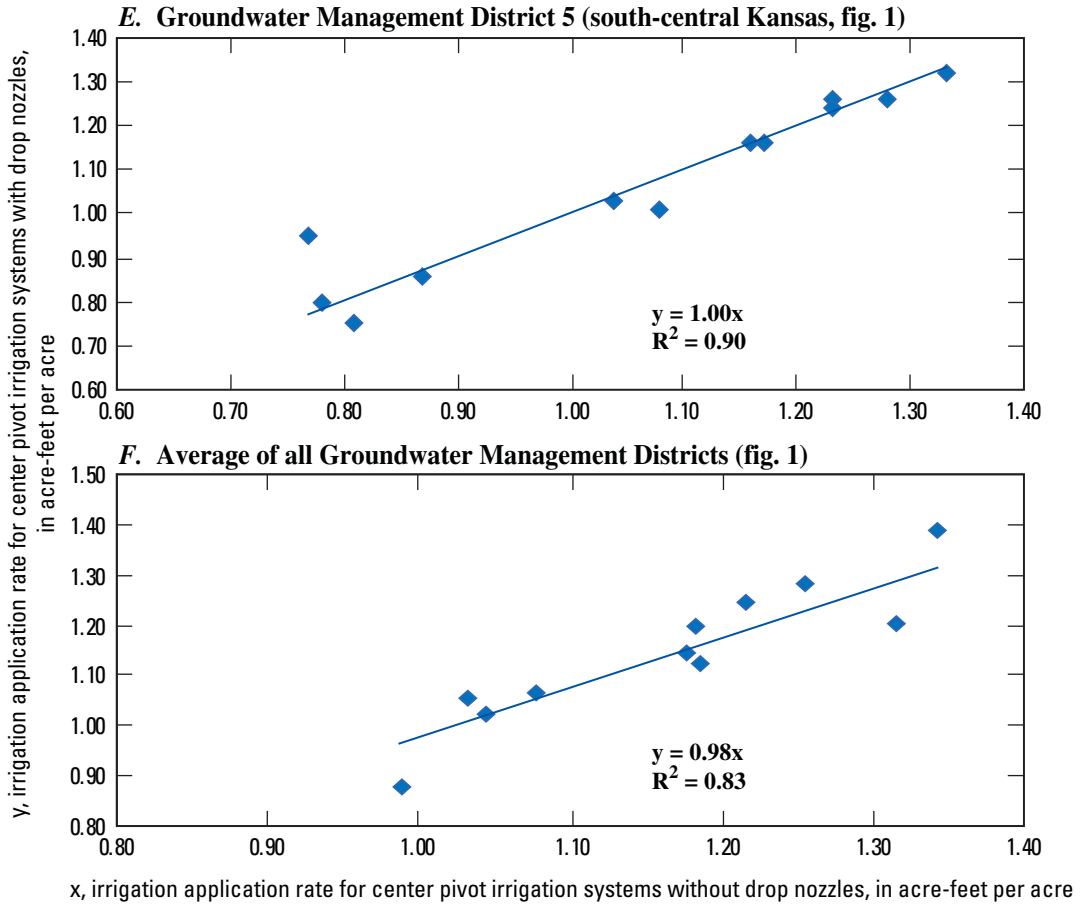


Figure 11. Relation between irrigation application rates for center pivot systems with and without drop nozzles for Groundwater Management Districts, 1992–2003.—Continued

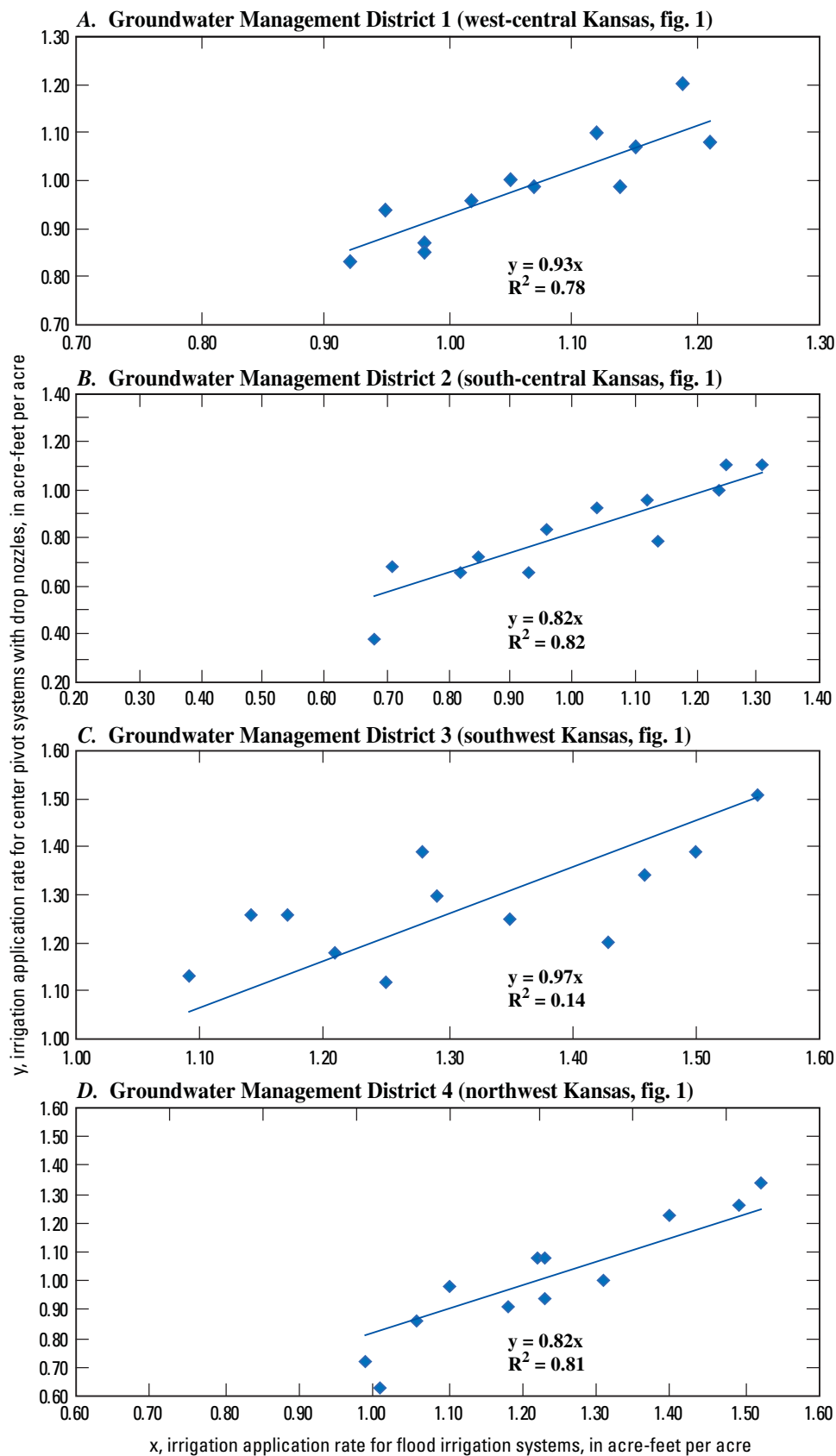


Figure 12. Relation between irrigation application rates for flood irrigation systems and center pivot systems with drop nozzles for Groundwater Management Districts, 1992–2003.

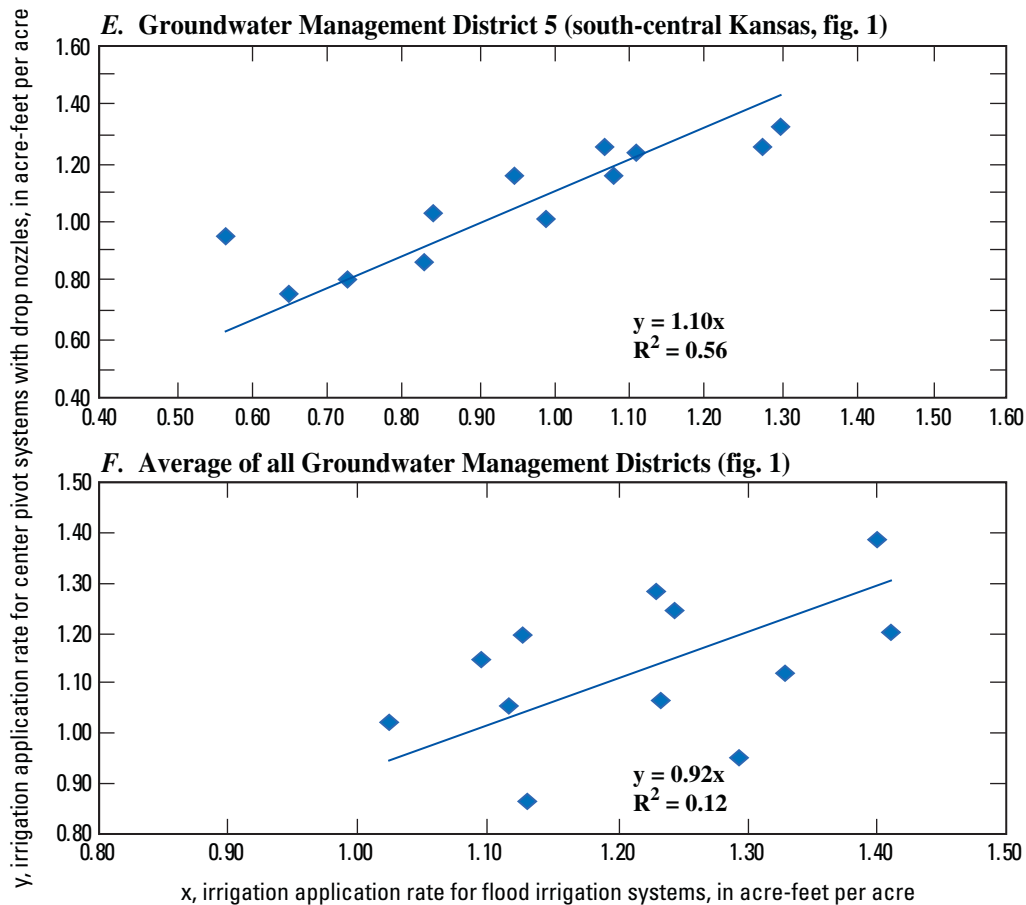


Figure 12. Relation between irrigation application rates for flood irrigation systems and center pivot systems with drop nozzles for Groundwater Management Districts, 1992–2003.—Continued

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Data Tables

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Barton County (estimated mean soil permeability = 1.2 inches per hour)																
1991	19.05	15.58	50,874	37,908	17,398	22,791	1.31	19,627	27,085	1.38	NA	NA	NA	883	997	1.13
1992	32.59	27.28	20,220	32,508	11,892	5,827	.49	18,745	13,496	.72	1,364	709	.52	507	187	.37
1993	38.22	32.97	17,959	31,882	12,137	6,554	.54	18,900	10,962	.58	428	223	.52	417	220	.53
1994	18.00	15.04	43,754	35,425	14,731	17,825	1.21	19,292	24,308	1.26	737	921	1.25	665	700	1.05
1995	26.55	25.38	33,487	36,004	15,547	13,837	.89	19,001	18,241	.96	914	960	1.05	542	450	.83
1996	31.52	28.74	33,203	36,416	14,864	13,080	.88	19,865	18,077	.91	1,170	1,310	1.12	517	735	1.42
1997	26.36	22.94	24,952	36,395	14,099	8,459	.60	14,978	10,934	.73	6,962	5,361	.77	356	198	.56
1998	29.69	23.58	30,239	36,235	13,526	10,145	.75	14,587	13,274	.91	7,677	6,525	.85	445	295	.66
1999	28.59	25.66	28,049	36,867	13,945	9,622	.69	14,042	11,936	.85	8,455	6,172	.73	425	319	.75
2000	29.32	24.67	38,111	37,538	13,014	12,624	.97	12,556	13,184	1.05	10,374	10,893	1.05	1,594	1,411	.88
2001	29.66	24.57	39,885	36,665	13,387	12,985	.97	10,933	12,573	1.15	11,660	13,292	1.14	685	1,034	1.51
2002	19.01	17.77	40,168	38,204	12,598	11,968	.95	6,917	7,678	1.11	16,438	18,082	1.10	2,251	2,440	1.08
2003	21.32	18.28	42,814	37,675	13,300	14,630	1.10	5,248	5,563	1.06	18,276	21,931	1.20	851	690	.81
Average	26.91	23.26	34,132	36,132	13,880	12,334	.87	14,976	14,409	.97	7,038	7,198	.94	780	744	.95
p-value	.50	--	.30	.01	--	--	--	--	--	--	--	--	--	--	--	--
Slope	-.33	--	1,196	293	--	--	--	--	--	--	--	--	--	--	--	--
Cheyenne County (estimated mean soil permeability = 1.3 inches per hour)																
1991	24.99	22.38	56,064	43,979	13,981	20,133	1.44	25,190	28,969	1.15	NA	NA	NA	4,808	6,962	1.45
1992	19.64	16.54	39,541	42,214	11,412	10,385	.91	23,686	21,317	.90	3,148	2,928	.93	3,968	4,911	1.24
1993	19.58	16.83	44,230	43,707	11,821	14,185	1.20	21,503	20,428	.95	4,969	4,224	.85	5,414	5,393	1.00
1994	15.40	12.63	55,075	45,719	10,592	15,358	1.45	23,107	25,649	1.11	6,618	6,883	1.04	5,402	7,186	1.33
1995	20.72	19.26	40,621	42,804	9,033	10,749	1.19	22,971	20,674	.90	7,261	5,301	.73	3,539	3,898	1.10
1996	19.19	18.35	48,994	46,737	8,912	11,853	1.33	25,035	24,034	.96	8,630	8,285	.96	4,160	4,823	1.16
1997	16.68	14.86	59,570	48,494	7,605	11,103	1.46	15,669	17,863	1.14	20,737	25,507	1.23	4,483	5,098	1.14
1998	19.26	16.67	49,947	47,522	5,514	7,278	1.32	11,581	11,813	1.02	24,751	25,494	1.03	5,676	5,362	.94
1999	18.36	17.33	49,835	47,593	5,421	7,156	1.32	12,309	12,186	.99	25,183	25,183	1.00	4,680	5,311	1.13
2000	15.58	14.31	65,272	49,219	4,093	6,753	1.65	10,037	11,743	1.17	30,458	41,118	1.35	4,631	5,657	1.22
2001	16.96	14.09	50,835	46,893	2,742	3,619	1.32	9,481	9,197	.97	28,817	30,834	1.07	5,853	7,185	1.23
2002	11.07	9.86	65,242	46,576	2,295	3,718	1.62	6,653	9,115	1.37	31,105	44,169	1.42	6,523	8,241	1.26

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Cheyenne County (estimated mean soil permeability = 1.3 inches per hour)—Continued																
2003	13.65	12.01	57,683	46,586	1,722	2,325	1.35	8,123	9,585	1.18	32,390	40,811	1.26	4,351	4,962	1.14
Average	17.78	15.78	52,531	46,003	7,319	9,586	1.35	16,565	17,121	1.06	18,672	21,728	1.07	4,884	5,768	1.18
p-value	0	--	.06	.06	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.67	--	1,248	395	--	--	--	--	--	--	--	--	--	--	--	--
Edwards County (estimated mean soil permeability = 3.9 inches per hour)																
1991	22.44	19.46	134,667	94,833	4,777	7,834	1.64	89,643	126,397	1.41	NA	NA	NA	413	436	1.06
1992	33.17	27.72	79,543	94,801	4,196	3,525	.84	86,595	73,606	.85	3,377	2,263	.67	633	150	.24
1993	32.52	27.05	75,378	92,703	3,935	3,187	.81	86,289	69,894	.81	1,909	2,176	1.14	570	121	.21
1994	18.87	15.59	124,957	93,019	2,871	4,393	1.53	88,052	117,990	1.34	1,325	1,776	1.34	771	800	1.04
1995	30.08	28.15	104,652	92,835	2,517	3,373	1.34	86,430	96,802	1.12	2,974	3,450	1.16	914	1,028	1.12
1996	37.37	34.80	74,959	94,891	2,659	2,047	.77	88,029	69,543	.79	3,052	2,289	.75	1,151	1,079	.94
1997	36.85	31.67	77,679	96,756	2,044	1,880	.92	74,943	60,704	.81	19,582	14,882	.76	187	212	1.13
1998	24.22	19.43	126,379	97,971	1,780	1,887	1.06	59,543	77,406	1.30	31,238	39,360	1.26	5,410	7,726	1.43
1999	25.11	22.16	108,909	100,065	1,885	2,055	1.09	58,763	65,227	1.11	35,849	38,000	1.06	3,568	3,628	1.02
2000	30.27	27.08	126,017	100,031	1,942	2,486	1.28	55,352	70,297	1.27	40,791	50,581	1.24	1,946	2,654	1.36
2001	24.34	20.55	127,470	99,786	1,771	2,107	1.19	43,471	55,643	1.28	46,696	59,771	1.28	7,848	9,949	1.27
2002	18.92	16.85	134,264	101,294	1,553	2,159	1.39	33,965	43,815	1.29	64,352	86,875	1.35	1,424	1,415	.99
2003	19.24	17.27	127,702	100,527	1,231	1,822	1.48	26,200	33,274	1.27	69,309	87,329	1.26	3,787	5,277	1.39
Average	27.18	23.68	109,429	96,886	2,551	2,981	1.18	67,483	73,892	1.13	26,705	32,396	1.11	2,202	2,652	1.20
p-value	.29	--	.10	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.99	--	2,800	754	--	--	--	--	--	--	--	--	--	--	--	--
Finney County (estimated mean soil permeability 1.9 inches per hour)																
1991	19.50	16.72	408,799	253,357	111,485	179,491	1.61	130,393	212,541	1.63	NA	NA	NA	11,479	16,768	1.46
1992	23.63	19.10	289,956	250,194	101,956	103,995	1.02	128,806	168,736	1.31	4,741	4,836	1.02	14,691	12,390	.84
1993	26.75	22.30	266,562	241,411	93,313	83,982	.90	118,936	149,859	1.26	11,946	17,800	1.49	17,216	14,921	.87
1994	17.85	15.47	348,399	243,085	89,163	114,129	1.28	117,657	183,545	1.56	16,478	28,013	1.70	19,787	22,712	1.15
1995	20.73	19.23	309,058	243,298	76,362	87,816	1.15	125,751	172,279	1.37	20,576	28,395	1.38	20,609	20,568	1.00
1996	22.74	21.06	296,412	240,283	74,761	88,218	1.18	118,068	149,946	1.27	30,627	41,040	1.34	16,827	17,208	1.02
1997	25.84	22.97	292,861	243,130	65,394	71,279	1.09	84,582	115,032	1.36	72,802	86,634	1.19	20,352	19,915	.98

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Graham County (estimated mean soil permeability = 1.5 inches per hour)																
1991	20.15	16.69	15,629	12,339	2,431	4,522	1.86	8,021	8,663	1.08	NA	NA	NA	1,887	2,445	1.30
1992	25.27	20.80	6,632	11,164	1,163	1,093	.94	7,514	4,058	.54	1,011	536	.53	1,476	945	.64
1993	37.58	33.44	3,122	8,888	939	714	.76	7,024	1,967	.28	383	153	.40	542	288	.53
1994	16.27	12.23	10,275	11,312	1,315	1,854	1.41	8,288	6,962	.84	762	686	.90	947	774	.82
1995	25.96	24.05	10,806	11,374	939	1,268	1.35	8,340	7,673	.92	1,282	1,051	.82	813	815	1.00
1996	26.44	23.19	9,708	12,164	962	1,126	1.17	8,793	6,683	.76	1,596	1,181	.74	813	719	.88
1997	22.51	19.12	11,448	12,604	859	1,220	1.42	6,874	5,912	.86	4,338	3,948	.91	533	369	.69
1998	23.74	19.41	11,531	13,764	564	778	1.38	6,524	5,219	.80	5,895	5,070	.86	781	463	.59
1999	20.92	19.64	9,626	13,838	515	659	1.28	6,819	4,705	.69	5,529	3,649	.66	975	612	.63
2000	20.00	17.32	14,681	14,590	659	1,061	1.61	6,661	6,128	.92	6,803	7,075	1.04	467	417	.89
2001	22.35	18.94	11,972	14,098	669	896	1.34	5,609	4,487	.80	7,085	5,810	.82	735	779	1.06
2002	14.40	13.55	17,127	14,774	479	666	1.39	4,347	4,434	1.02	9,139	10,784	1.18	809	1,243	1.54
2003	13.65	12.39	15,383	14,759	428	496	1.16	4,512	4,422	.98	8,649	9,254	1.07	1,170	1,210	1.03
Average	22.25	19.29	11,380	12,744	917	1,258	1.31	6,871	5,485	.81	4,373	4,100	.83	919	852	.93
p-value	.04	--	.03	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.83	--	695	392	--	--	--	--	--	--	--	--	--	--	--	--
Grant County (estimated mean soil permeability = 2.4 inches per hour)																
1991	19.36	16.62	236,163	142,038	86,579	139,392	1.61	37,394	65,440	1.75	NA	NA	NA	18,065	31,331	1.73
1992	11.79	9.20	212,451	143,886	84,177	122,057	1.45	36,900	58,302	1.58	9,136	12,973	1.42	13,673	19,120	1.40
1993	22.60	18.81	158,507	138,752	67,988	74,787	1.10	41,424	54,680	1.32	8,413	8,750	1.04	20,927	20,291	.97
1994	17.36	15.90	196,856	139,096	58,423	82,376	1.41	41,965	62,948	1.50	11,676	14,829	1.27	27,032	36,704	1.36
1995	15.45	15.20	186,807	136,205	45,898	65,175	1.42	44,565	61,945	1.39	12,453	15,691	1.26	33,289	43,996	1.32
1996	22.56	21.32	172,941	134,228	42,468	54,784	1.29	44,736	61,736	1.38	11,824	13,243	1.12	35,200	43,178	1.23
1997	19.29	18.55	144,617	137,703	32,925	32,925	1.00	29,835	34,012	1.14	35,910	38,783	1.08	39,033	38,897	1.00
1998	16.57	14.65	143,152	134,983	24,581	21,385	.87	26,822	33,259	1.24	40,744	48,485	1.19	42,836	40,021	.93
1999	15.44	13.97	144,243	130,566	18,429	17,508	.95	25,199	32,759	1.30	45,725	50,755	1.11	41,213	43,222	1.05
2000	18.50	17.75	167,867	126,929	11,195	11,419	1.02	25,795	37,661	1.46	50,422	71,599	1.42	39,517	47,188	1.19
2001	16.91	16.04	121,369	119,984	7,202	5,762	.80	20,825	22,283	1.07	51,413	57,068	1.11	40,544	36,256	.89
2002	11.75	10.86	166,915	120,861	6,089	7,611	1.25	14,604	19,715	1.35	65,494	95,621	1.46	34,674	43,967	1.27

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Grant County (estimated mean soil permeability = 2.4 inches per hour)—Continued																
2003	15.32	14.33	144,167	117,232	4,551	4,278	0.94	14,137	17,954	1.27	63,792	86,119	1.35	34,752	35,816	1.03
Average	17.15	15.63	168,927	132,497	37,731	49,189	1.16	31,092	43,284	1.37	33,917	42,826	1.24	32,366	36,922	1.14
p-value	.10	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.36	--	-6,778	-2,172	--	--	--	--	--	--	--	--	--	--	--	--
Gray County (estimated mean soil permeability = 2.0 inches per hour)																
1991	20.96	17.64	318,248	197,652	65,390	115,740	1.77	118,959	183,197	1.54	NA	NA	NA	13,303	19,311	1.45
1992	27.71	21.25	234,663	192,815	62,571	82,594	1.32	104,756	122,565	1.17	12,741	15,799	1.24	12,747	13,706	1.08
1993	27.37	21.75	210,610	187,749	54,146	67,141	1.24	116,515	128,167	1.10	4,963	3,921	.79	12,125	11,382	.94
1994	17.32	15.18	255,990	189,857	48,740	74,572	1.53	112,570	147,467	1.31	11,809	15,116	1.28	16,738	18,835	1.13
1995	19.81	18.50	249,139	191,401	41,995	66,352	1.58	117,669	143,556	1.22	15,315	19,297	1.26	16,422	19,934	1.21
1996	30.99	29.49	217,497	188,268	33,518	46,255	1.38	123,790	136,169	1.10	12,301	14,269	1.16	18,659	20,804	1.11
1997	22.85	20.12	223,707	193,405	20,748	28,010	1.35	86,094	94,703	1.10	62,101	75,142	1.21	24,462	25,852	1.06
1998	18.15	15.35	254,503	194,869	16,422	26,275	1.60	76,398	97,789	1.28	76,388	100,068	1.31	25,661	30,370	1.18
1999	23.29	22.06	207,754	196,852	13,436	17,198	1.28	70,347	70,347	1.00	86,700	93,636	1.08	26,369	26,573	1.01
2000	17.48	16.46	262,448	196,639	11,805	18,180	1.54	54,826	66,888	1.22	104,458	141,018	1.35	25,550	36,362	1.42
2001	17.05	14.87	242,452	193,058	9,062	12,868	1.42	58,037	66,743	1.15	103,222	132,124	1.28	22,737	30,717	1.35
2002	12.85	11.64	268,045	184,726	7,280	13,031	1.79	50,502	66,158	1.31	102,352	150,457	1.47	24,592	38,399	1.56
2003	19.73	17.98	233,741	181,426	5,429	7,221	1.33	33,938	46,156	1.36	121,067	153,755	1.27	20,992	26,610	1.27
Average	21.20	18.64	244,523	191,440	30,042	44,264	1.47	86,492	105,377	1.22	59,451	76,217	1.23	20,027	24,527	1.22
p-value	.06	--	1.0	.58	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.60	--	390	-367	--	--	--	--	--	--	--	--	--	--	--	--
Greeley County (estimated mean soil permeability = 1.2 inches per hour)																
1991	20.55	17.42	39,803	27,211	18,519	27,779	1.50	6,950	10,008	1.44	NA	NA	NA	1,742	2,016	1.16
1992	19.82	16.23	34,118	28,347	14,819	19,265	1.30	6,245	5,308	.85	5,264	7,264	1.38	2,019	2,281	1.13
1993	20.67	16.74	28,895	26,874	14,138	15,552	1.10	5,227	4,809	.92	5,686	6,994	1.23	1,823	1,541	.85
1994	18.76	17.04	34,724	27,044	13,187	17,143	1.30	7,325	9,889	1.35	3,189	3,572	1.12	3,343	4,121	1.23
1995	18.64	17.35	28,223	28,029	10,372	11,513	1.11	4,971	5,468	1.10	10,651	9,692	.91	2,035	1,549	.76
1996	21.88	21.10	32,404	29,743	8,163	10,122	1.24	7,167	7,310	1.02	12,336	13,323	1.08	2,077	1,649	.79

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Greeley County (estimated mean soil permeability = 1.2 inches per hour)—Continued																
1997	24.72	21.91	28,153	28,997	7,367	7,809	1.06	3,697	3,660	0.99	15,912	14,639	0.92	2,021	2,045	1.01
1998	17.49	15.20	27,964	30,367	5,755	5,813	1.01	4,571	4,525	.99	18,248	15,876	.87	1,793	1,750	.98
1999	21.38	20.24	26,227	29,740	5,299	5,140	.97	3,694	3,288	.89	17,439	15,172	.87	3,308	2,627	.79
2000	14.67	13.46	31,874	29,451	3,120	3,557	1.14	3,859	3,782	.98	19,758	20,943	1.06	2,714	3,592	1.32
2001	13.07	10.98	28,056	28,464	2,056	2,611	1.27	3,475	3,614	1.04	20,786	19,955	.96	2,147	1,876	.87
2002	10.21	9.62	33,752	29,261	2,377	2,971	1.25	3,304	3,833	1.16	21,563	23,935	1.11	2,017	3,013	1.49
2003	16.70	15.83	28,574	28,438	2,012	2,072	1.03	2,350	2,609	1.11	21,347	20,493	.96	2,729	3,400	1.25
Average	18.35	16.39	30,982	28,613	8,245	10,104	1.18	4,833	5,239	1.06	14,348	14,321	1.04	2,290	2,420	1.06
p-value	.04	--	.08	.16	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.64	--	-436	156	--	--	--	--	--	--	--	--	--	--	--	--
Harvey County (estimated mean soil permeability = 1.2 inches per hour)																
1991	24.96	20.20	32,641	27,337	11,421	15,190	1.33	13,860	15,662	1.13	NA	NA	NA	2,056	1,789	.87
1992	34.89	24.94	18,593	26,211	10,302	8,139	.79	14,416	9,515	.66	133	64	.48	1,360	876	.64
1993	41.21	35.35	16,865	25,369	9,360	6,739	.72	14,524	9,586	.66	97	60	.62	1,388	480	.35
1994	25.42	20.85	29,135	26,878	9,941	11,730	1.18	15,278	16,042	1.05	79	27	.34	1,580	1,336	.85
1995	36.75	35.03	24,695	27,701	9,106	9,015	.99	16,288	14,008	.86	277	177	.64	2,030	1,496	.74
1996	32.07	27.79	24,981	28,860	9,167	8,892	.97	17,345	14,570	.84	165	101	.61	2,183	1,418	.65
1997	33.20	27.05	21,350	29,390	8,309	6,564	.79	13,498	10,124	.75	5,359	3,376	.63	2,224	1,286	.58
1998	39.72	27.71	27,425	30,126	8,354	8,438	1.01	10,623	8,817	.83	8,254	8,006	.97	2,895	2,164	.75
1999	36.76	30.70	23,261	30,000	7,432	6,689	.90	9,320	6,244	.67	10,810	8,756	.81	2,438	1,572	.64
2000	29.09	25.00	30,603	31,432	8,274	9,019	1.09	4,823	4,341	.90	14,126	13,561	.96	4,209	3,683	.87
2001	29.09	23.98	35,737	31,181	7,812	9,531	1.22	5,722	6,294	1.10	14,848	16,778	1.13	2,799	3,134	1.12
2002	28.61	26.03	33,307	31,844	7,852	9,658	1.23	3,774	3,472	.92	17,267	17,440	1.01	2,951	2,737	.93
2003	36.05	33.02	37,459	32,962	7,119	9,326	1.31	3,514	3,444	.98	18,098	20,089	1.11	4,231	4,601	1.09
Average	32.91	27.51	27,389	29,176	8,804	9,148	1.04	10,999	9,394	.87	7,459	7,370	.78	2,488	2,044	.82
p-value	1.0	--	.03	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.04	--	1,291	614	--	--	--	--	--	--	--	--	--	--	--	--

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Haskell County (estimated mean soil permeability = 2.0 inches per hour)																
1991	16.18	13.32	390,649	218,666	173,326	306,787	1.77	27,151	45,614	1.68	NA	NA	NA	18,189	38,248	2.10
1992	16.77	12.91	331,144	217,245	162,954	257,467	1.58	30,958	43,651	1.41	3,282	2,954	.90	20,051	27,072	1.35
1993	22.20	18.05	280,433	216,578	150,017	204,023	1.36	37,417	45,275	1.21	3,649	3,977	1.09	25,495	27,158	1.07
1994	16.28	14.87	338,265	218,088	130,875	215,944	1.65	39,261	55,358	1.41	4,621	7,255	1.57	43,331	59,708	1.38
1995	14.73	13.80	322,206	213,309	98,663	160,821	1.63	53,293	74,077	1.39	3,383	3,451	1.02	57,970	83,857	1.45
1996	23.93	22.40	283,368	212,300	79,310	122,931	1.55	61,830	72,341	1.17	2,978	2,561	.86	68,182	85,536	1.25
1997	21.71	19.58	266,590	213,416	68,622	98,129	1.43	40,655	51,225	1.26	42,412	50,470	1.19	61,727	66,765	1.08
1998	18.74	16.04	259,642	214,409	57,196	77,215	1.35	41,452	50,986	1.23	47,060	57,413	1.22	68,701	74,028	1.08
1999	23.81	22.25	230,834	212,874	46,298	60,187	1.30	40,815	43,672	1.07	46,806	51,019	1.09	78,955	75,956	.96
2000	17.28	16.42	275,682	210,115	39,840	58,963	1.48	29,624	38,807	1.31	66,585	87,892	1.32	74,066	90,019	1.22
2001	12.63	10.37	240,724	200,480	31,059	43,483	1.40	23,428	26,942	1.15	77,448	94,487	1.22	68,545	75,813	1.11
2002	11.86	10.72	303,666	213,401	25,285	47,030	1.86	25,650	34,371	1.34	76,074	103,461	1.36	86,392	118,804	1.38
2003	13.98	13.14	249,435	199,953	18,106	28,245	1.56	20,536	22,590	1.10	76,927	96,928	1.26	84,384	101,672	1.20
Average	17.70	15.68	290,203	212,372	83,196	129,325	1.53	36,313	46,531	1.29	37,602	46,822	1.18	58,153	71,126	1.22
p-value	.30	--	.01	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.36	--	-8,922	-979	--	--	--	--	--	--	--	--	--	--	--	--
Kearny County (estimated mean soil permeability = 2.4 inches per hour)																
1991	18.76	15.75	168,070	98,578	46,072	65,883	1.43	48,078	91,829	1.91	NA	NA	NA	4,428	10,358	2.34
1992	18.62	15.54	133,546	97,766	46,238	45,776	.99	47,605	82,357	1.73	629	1,107	1.76	3,294	4,306	1.31
1993	21.65	18.33	125,288	98,361	42,890	37,743	.88	49,430	80,571	1.63	1,555	2,208	1.42	4,486	4,766	1.06
1994	24.22	22.10	149,561	97,871	35,785	42,942	1.20	49,623	88,825	1.79	3,394	4,718	1.39	9,069	13,076	1.44
1995	20.98	20.42	129,483	96,063	30,170	27,455	.91	46,772	78,577	1.68	6,656	8,253	1.24	12,465	15,198	1.22
1996	23.20	22.29	131,765	97,004	28,028	27,187	.97	52,148	84,480	1.62	6,699	9,379	1.40	10,129	10,719	1.06
1997	24.42	22.38	131,882	104,172	25,776	20,621	.80	38,677	61,883	1.60	25,973	37,141	1.43	13,746	12,236	.89
1998	20.96	17.67	131,906	103,819	22,644	16,530	.73	42,474	67,534	1.59	23,093	33,947	1.47	15,608	13,895	.89
1999	16.75	15.35	133,931	103,050	20,706	14,908	.72	35,116	53,025	1.51	32,607	50,215	1.54	14,621	15,782	1.08
2000	17.01	15.94	161,529	103,217	18,780	16,526	.88	15,867	30,147	1.90	56,383	101,489	1.80	12,187	13,365	1.10
2001	18.86	16.84	132,076	101,111	18,118	11,958	.66	12,852	19,792	1.54	54,961	85,739	1.56	15,180	14,587	.96
2002	10.51	9.43	185,629	107,275	17,534	23,846	1.36	12,711	25,803	2.03	59,970	112,144	1.87	17,060	23,835	1.40

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Kearny County (estimated mean soil permeability = 2.4 inches per hour)—Continued																
2003	18.06	16.36	146,641	103,846	14,169	13,886	0.98	11,731	19,122	1.63	59,041	91,514	1.55	18,905	22,120	1.17
Average	19.54	17.57	143,177	100,933	28,224	28,097	.96	35,622	60,303	1.70	27,580	44,821	1.54	11,629	13,403	1.15
p-value	.16	--	.20	.06	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.36	--	936	642	--	--	--	--	--	--	--	--	--	--	--	--
Kiowa County (estimated mean soil permeability = 3.7 inches per hour)																
1991	18.77	15.65	75,245	49,214	1,426	2,467	1.73	46,826	71,644	1.53	NA	NA	NA	962	1,134	1.18
1992	26.89	22.47	47,130	48,883	936	936	1.00	46,425	44,568	.96	1,075	1,118	1.04	447	508	1.14
1993	31.50	26.32	51,802	48,559	930	1,163	1.25	45,279	47,543	1.05	1,546	2,180	1.41	804	917	1.14
1994	21.60	18.17	66,869	48,812	1,044	1,608	1.54	45,630	62,969	1.38	1,777	2,044	1.15	361	249	.69
1995	24.59	23.28	55,885	48,684	868	1,215	1.40	45,470	52,291	1.15	1,714	1,937	1.13	632	442	.70
1996	31.44	29.14	45,897	50,672	830	838	1.01	46,147	41,994	.91	3,022	2,508	.83	673	557	.83
1997	31.01	26.89	44,379	51,365	585	649	1.11	32,328	27,479	.85	18,164	16,166	.89	288	85	.29
1998	22.41	18.17	69,232	51,852	604	918	1.52	25,207	33,525	1.33	23,721	32,023	1.35	2,320	2,765	1.19
1999	21.66	20.55	59,727	52,023	409	519	1.27	23,074	26,535	1.15	25,932	30,081	1.16	2,608	2,591	.99
2000	33.72	31.02	64,090	51,852	261	326	1.25	16,010	20,013	1.25	33,672	42,090	1.25	1,909	1,661	.87
2001	24.16	17.81	70,605	51,539	413	297	.72	15,593	22,454	1.44	33,846	45,692	1.35	1,687	2,161	1.28
2002	22.33	20.85	69,065	52,851	431	491	1.14	12,353	17,788	1.44	37,464	47,205	1.26	2,603	3,581	1.38
2003	19.00	17.31	67,440	52,629	385	485	1.26	10,304	14,838	1.44	39,894	49,070	1.23	2,046	3,047	1.49
Average	25.31	22.13	60,567	50,687	702	916	1.25	31,588	37,203	1.22	18,486	22,676	1.17	1,334	1,515	1.14
p-value	.67	--	.36	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.20	--	1,382	360	--	--	--	--	--	--	--	--	--	--	--	--
Lane County (estimated mean soil permeability = 1.2 inches per hour)																
1991	21.56	18.74	27,668	24,427	21,865	26,019	1.19	1,707	1,349	.79	NA	NA	NA	855	300	.35
1992	25.66	20.44	16,615	20,264	15,898	14,785	.93	2,301	1,220	.53	0	0	0	2,065	610	.30
1993	29.73	23.97	11,164	17,080	13,171	9,351	.71	1,821	819	.45	490	431	.88	1,598	562	.35
1994	22.78	18.73	20,020	18,490	14,635	16,099	1.10	1,508	1,191	.79	864	1,140	1.32	1,483	1,590	1.07
1995	21.13	20.07	21,075	21,705	14,669	15,402	1.05	1,729	1,245	.72	1,305	1,736	1.33	4,002	2,692	.67
1996	32.79	31.21	15,347	21,230	13,299	10,240	.77	2,014	1,611	.80	2,168	1,734	.80	3,749	1,761	.47

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Meade County (estimated mean soil permeability = 2.2 inches per hour)																
1991	19.14	14.88	216,129	124,784	84,112	160,654	1.91	23,287	31,670	1.36	NA	NA	NA	17,385	23,805	1.37
1992	18.90	15.02	168,859	123,552	84,747	126,273	1.49	24,077	24,318	1.01	1,070	1,102	1.03	13,658	17,166	1.26
1993	17.89	13.88	161,882	124,442	83,461	120,184	1.44	25,808	26,066	1.01	2,000	1,700	.85	13,173	13,932	1.06
1994	21.87	20.34	182,199	122,846	73,467	119,017	1.62	28,608	35,760	1.25	2,768	3,654	1.32	18,003	23,769	1.32
1995	20.66	19.43	173,885	119,254	65,295	102,513	1.57	31,331	41,357	1.32	1,091	1,353	1.24	21,537	28,662	1.33
1996	26.76	23.53	166,599	124,793	65,867	97,483	1.48	38,692	44,109	1.14	1,728	1,503	.87	18,506	23,504	1.27
1997	28.14	22.48	144,351	124,399	48,169	61,656	1.28	26,595	27,925	1.05	20,463	22,919	1.12	29,172	31,852	1.09
1998	27.42	26.46	170,925	124,726	34,202	51,987	1.52	22,098	28,064	1.27	32,483	42,878	1.32	35,943	47,996	1.34
1999	27.35	26.19	142,101	126,820	28,241	36,431	1.29	21,333	24,106	1.13	38,255	41,315	1.08	38,991	40,248	1.03
2000	21.38	19.82	179,978	128,336	25,546	39,341	1.54	14,869	22,304	1.50	51,214	71,187	1.39	36,707	47,146	1.28
2001	24.63	16.92	160,400	118,987	16,424	23,486	1.43	15,242	22,558	1.48	51,326	67,750	1.32	35,995	46,605	1.29
2002	23.36	21.06	201,544	125,890	17,978	28,945	1.61	16,013	27,382	1.71	53,905	87,326	1.62	37,994	57,891	1.52
2003	33.72	32.41	156,630	122,229	13,148	16,829	1.28	11,734	13,025	1.11	57,672	77,280	1.34	39,675	49,495	1.25
Average	23.94	20.96	171,191	123,928	49,281	75,754	1.50	23,053	28,357	1.26	26,165	34,997	1.21	27,441	34,775	1.27
p-value	.03	--	.30	.76	--	--	--	--	--	--	--	--	--	--	--	--
slope	.87	--	-1,282	108	--	--	--	--	--	--	--	--	--	--	--	--
Morton County (estimated mean soil permeability = 2.5 inches per hour)																
1991	18.40	15.50	83,832	50,778	34,871	58,235	1.67	10,113	16,080	1.59	NA	NA	NA	5,794	9,518	1.64
1992	14.92	12.70	74,013	49,648	31,931	47,897	1.50	7,448	10,278	1.38	2,112	2,577	1.22	8,157	13,261	1.63
1993	19.65	16.43	67,257	53,025	28,607	36,903	1.29	12,580	16,228	1.29	2,163	2,877	1.33	9,675	11,249	1.16
1994	18.51	16.85	65,899	52,123	24,102	30,128	1.25	12,262	16,799	1.37	2,835	2,920	1.03	12,924	16,052	1.24
1995	15.74	14.41	60,528	49,624	18,184	22,730	1.25	14,203	16,902	1.19	3,755	4,243	1.13	13,482	16,654	1.24
1996	21.78	20.79	56,036	52,208	19,814	19,616	.99	13,032	14,726	1.13	5,213	6,256	1.20	14,149	15,438	1.09
1997	19.30	17.10	53,473	50,965	13,122	11,941	.91	13,205	14,790	1.12	14,112	15,100	1.07	10,526	11,642	1.11
1998	20.92	18.63	54,533	49,924	8,182	7,527	.92	11,243	12,929	1.15	19,675	21,446	1.09	10,824	12,630	1.17
1999	18.14	16.87	48,298	52,460	8,755	7,267	.83	11,255	11,368	1.01	24,146	21,973	.91	8,304	7,691	.93
2000	16.54	16.01	55,442	50,547	6,666	6,799	1.02	11,228	13,698	1.22	26,148	29,286	1.12	6,505	5,659	.87
2001	18.53	16.02	44,290	47,586	5,580	3,683	.66	11,320	12,905	1.14	22,464	21,116	.94	8,222	6,586	.80
2002	13.09	11.43	49,960	42,406	3,146	3,870	1.23	7,323	9,666	1.32	24,593	28,282	1.15	7,344	8,143	1.11

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Morton County (estimated mean soil permeability = 2.5 inches per hour)—Continued																
2003	19.22	17.38	39,507	42,786	1,954	1,583	0.81	11,127	10,682	0.96	24,391	21,464	0.88	5,314	5,779	1.09
Average	18.06	16.16	57,928	49,545	15,763	19,860	1.10	11,257	13,619	1.22	14,301	14,795	1.09	9,325	10,792	1.16
p-value	.67	--	0	.08	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.09	--	-2,968	-532	--	--	--	--	--	--	--	--	--	--	--	--
Pawnee County (estimated mean soil permeability = 1.2 inches per hour)																
1991	14.08	10.72	106,932	77,085	35,727	54,662	1.53	40,418	50,523	1.25	NA	NA	NA	940	1,747	1.86
1992	32.14	26.55	45,543	70,536	29,419	18,240	.62	38,004	25,463	.67	1,734	1,231	.71	1,379	609	.44
1993	38.05	30.99	31,209	64,354	23,952	10,778	.45	38,512	19,256	.50	723	289	.40	1,167	885	.76
1994	14.83	11.72	90,564	74,522	31,653	39,250	1.24	40,513	49,021	1.21	423	326	.77	1,933	1,968	1.02
1995	24.52	22.38	75,112	77,576	33,064	31,411	.95	39,920	39,122	.98	3,124	3,186	1.02	1,468	1,393	.95
1996	32.01	28.58	53,184	74,372	27,290	20,468	.75	40,253	28,177	.70	4,932	3,600	.73	1,897	939	.49
1997	27.34	23.64	53,515	75,503	24,555	18,171	.74	28,019	19,333	.69	19,278	13,880	.72	3,651	2,131	.58
1998	25.25	20.51	77,546	80,600	24,263	22,807	.94	22,154	21,711	.98	29,720	28,531	.96	4,463	4,497	1.01
1999	24.92	22.32	67,624	80,135	22,619	18,774	.83	21,726	18,684	.86	31,173	27,121	.87	4,617	3,045	.66
2000	26.74	23.08	84,802	79,215	19,061	21,348	1.12	16,664	18,830	1.13	37,624	38,753	1.03	5,866	5,870	1.00
2001	24.35	20.94	82,947	79,534	18,317	19,233	1.05	11,907	11,907	1.00	43,371	45,973	1.06	5,939	5,834	.98
2002	17.37	15.98	94,792	79,512	16,944	19,655	1.16	11,734	14,198	1.21	43,154	51,353	1.19	7,680	9,586	1.25
2003	19.06	17.12	83,221	74,912	12,124	15,276	1.26	9,905	10,995	1.11	45,815	49,938	1.09	7,068	7,012	.99
Average	24.66	21.12	72,846	75,989	24,538	23,852	.97	27,671	25,171	.95	21,756	22,015	.88	3,698	3,501	.95
p-value	.30	--	.20	.10	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.81	--	2,374	450	--	--	--	--	--	--	--	--	--	--	--	--
Pratt County (estimated mean soil permeability = 4.1 inches per hour)																
1991	28.72	24.61	97,761	71,656	1,838	2,831	1.54	67,299	91,527	1.36	NA	NA	NA	2,519	3,404	1.35
1992	27.42	22.73	62,151	70,424	1,687	1,805	1.07	64,142	57,086	.89	2,882	2,306	.80	1,713	954	.56
1993	33.23	27.98	68,322	70,944	1,759	1,812	1.03	66,325	63,672	.96	1,328	1,687	1.27	1,532	1,151	.75
1994	19.40	16.31	102,272	71,198	1,470	2,984	2.03	65,759	93,378	1.42	1,866	2,762	1.48	2,103	3,149	1.50
1995	26.11	23.76	82,056	70,901	1,269	2,119	1.67	65,473	75,949	1.16	2,457	2,138	.87	1,702	1,850	1.09
1996	33.15	29.09	68,821	71,351	1,546	1,701	1.10	65,598	62,974	.96	2,925	2,984	1.02	1,282	1,163	.91

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Pratt County (estimated mean soil permeability = 4.1 inches per hour)—Continued																
1997	34.67	28.46	57,970	73,131	1,349	1,187	0.88	46,462	35,311	0.76	24,132	20,754	0.86	1,188	718	0.60
1998	24.23	19.06	92,301	75,305	1,183	1,644	1.39	37,791	45,727	1.21	34,652	42,968	1.24	1,679	1,962	1.17
1999	28.26	25.52	92,628	80,233	1,165	1,445	1.24	39,427	44,553	1.13	37,541	44,674	1.19	2,100	1,958	.93
2000	34.92	29.51	91,301	81,714	920	1,040	1.13	28,988	32,177	1.11	49,397	55,325	1.12	2,409	2,760	1.15
2001	15.01	12.75	109,599	82,459	957	1,522	1.59	22,725	29,543	1.30	55,908	74,917	1.34	2,869	3,618	1.26
2002	28.14	24.83	99,366	83,607	672	753	1.12	22,221	26,443	1.19	57,178	68,042	1.19	3,536	4,129	1.17
2003	24.43	21.40	110,278	84,191	887	1,153	1.30	23,435	30,934	1.32	57,402	74,623	1.30	2,467	3,568	1.45
Average	27.51	23.54	87,294	75,932	1,285	1,692	1.31	47,357	53,021	1.14	27,306	32,765	1.14	2,085	2,337	1.12
p-value	.67	--	.06	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.13	--	3,349	1,285	--	--	--	--	--	--	--	--	--	--	--	--
Rawlins County (estimated mean soil permeability = 1.3 inches per hour)																
1991	22.55	19.27	19,212	16,397	4,826	6,805	1.41	6,899	6,416	.93	NA	NA	NA	4,672	5,991	1.28
1992	25.11	21.63	9,316	14,753	4,225	3,549	.84	5,686	2,786	.49	1,580	980	.62	3,262	2,001	.61
1993	26.89	23.19	10,943	15,300	3,305	3,636	1.10	6,642	3,919	.59	2,711	1,762	.65	2,642	1,627	.62
1994	23.14	18.97	15,870	17,909	3,377	3,884	1.15	6,974	5,091	.73	2,364	1,962	.83	5,194	4,933	.95
1995	22.49	21.33	16,629	19,293	2,779	3,363	1.21	8,747	6,298	.72	3,414	2,902	.85	4,353	4,066	.93
1996	25.16	23.97	13,625	17,245	2,685	2,631	.98	5,862	4,455	.76	4,770	3,053	.64	3,928	3,486	.89
1997	18.36	16.25	19,379	17,932	2,508	3,536	1.41	4,463	4,954	1.11	7,329	7,695	1.05	3,632	3,193	.88
1998	21.08	18.48	16,211	17,904	1,864	2,125	1.14	4,316	4,273	.99	7,509	6,308	.84	4,215	3,506	.83
1999	21.43	20.77	12,993	17,288	1,522	1,233	.81	3,195	2,876	.90	8,840	6,276	.71	3,731	2,608	.70
2000	17.93	15.22	23,121	18,259	1,296	1,737	1.34	2,205	2,514	1.14	10,311	13,611	1.32	4,447	5,260	1.18
2001	21.52	18.43	16,039	17,995	1,351	1,689	1.25	2,057	1,810	.88	10,603	9,543	.90	3,984	2,997	.75
2002	11.09	9.95	23,276	19,099	1,321	1,625	1.23	2,282	2,350	1.03	10,658	13,536	1.27	4,838	5,765	1.19
2003	17.07	15.79	19,454	19,110	1,560	2,122	1.36	1,924	1,751	.91	11,122	10,900	.98	4,504	4,682	1.04
Average	21.06	18.71	16,621	17,576	2,509	2,918	1.17	4,712	3,807	.86	6,768	6,544	.89	4,108	3,855	.94
p-value	.01	--	.06	.01	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.69	--	752	249	--	--	--	--	--	--	--	--	--	--	--	--

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Reno County (estimated mean soil permeability = 4.7 inches per hour)																
1991	25.65	22.30	38,133	33,755	3,457	3,492	1.01	26,698	31,237	1.17	NA	NA	NA	3,600	3,405	0.95
1992	31.52	25.07	20,433	31,999	3,084	1,881	.61	25,281	16,180	.64	1,123	752	.67	2,511	1,619	.64
1993	33.54	28.38	21,051	31,549	2,393	1,340	.56	25,571	17,388	.68	1,071	793	.74	2,514	1,530	.61
1994	24.01	20.01	34,772	33,232	2,371	2,086	.88	26,874	28,486	1.06	323	210	.65	3,664	3,989	1.09
1995	33.31	31.60	29,421	33,164	2,139	1,604	.75	27,867	25,080	.90	623	617	.99	2,535	2,120	.84
1996	26.01	22.69	31,536	36,923	1,869	1,589	.85	30,830	26,514	.86	1,520	1,170	.77	2,704	2,263	.84
1997	32.22	27.16	27,613	38,161	1,859	1,153	.62	20,885	15,455	.74	13,694	9,586	.70	1,723	1,420	.82
1998	32.04	24.70	41,331	40,263	1,533	1,134	.74	17,345	17,865	1.03	17,232	18,094	1.05	4,153	4,238	1.02
1999	30.67	26.86	38,276	44,301	1,826	1,059	.58	16,148	15,179	.94	23,077	19,385	.84	3,250	2,653	.82
2000	33.67	28.20	48,685	44,632	1,842	1,750	.95	11,720	12,423	1.06	29,050	32,827	1.13	2,020	1,686	.83
2001	26.59	21.68	53,643	46,125	1,755	1,878	1.07	11,853	12,564	1.06	29,418	35,890	1.22	3,099	3,311	1.07
2002	32.16	28.67	49,356	47,673	1,787	1,716	.96	12,105	13,073	1.08	29,200	30,368	1.04	4,581	4,199	.92
2003	32.18	29.13	55,372	47,766	1,520	1,854	1.22	10,340	11,271	1.09	31,749	38,099	1.20	4,157	4,149	1.00
Average	30.27	25.88	37,663	39,196	2,110	1,734	.83	20,271	18,670	.95	14,840	15,649	.92	3,116	2,814	.90
p-value	.43	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	.07	--	2,859	1,618	--	--	--	--	--	--	--	--	--	--	--	--
Rice County (estimated mean soil permeability = 1.8 inches per hour)																
1991	18.89	15.39	27,412	21,182	2,087	2,880	1.38	18,402	23,555	1.28	NA	NA	NA	693	978	1.41
1992	33.86	29.18	10,793	20,546	1,714	1,063	.62	17,344	8,672	.50	1,124	652	.58	364	406	1.12
1993	39.15	33.31	9,966	19,863	1,257	528	.42	17,119	8,560	.50	1,045	784	.75	442	94	.21
1994	17.56	14.41	25,946	21,450	1,598	2,125	1.33	17,809	21,549	1.21	1,360	1,836	1.35	683	436	.64
1995	31.48	29.67	17,621	20,314	1,252	1,064	.85	17,032	14,477	.85	1,421	1,336	.94	609	744	1.22
1996	25.97	22.12	19,344	21,446	1,358	1,317	.97	17,893	15,746	.88	2,030	2,050	1.01	165	230	1.39
1997	3.46	25.83	17,739	21,752	1,120	1,109	.99	12,555	10,295	.82	7,767	6,058	.78	310	277	.89
1998	28.93	24.07	18,857	21,815	1,236	1,075	.87	12,563	10,553	.84	7,703	6,933	.90	313	296	.95
1999	26.46	23.32	20,041	22,803	1,276	1,059	.83	9,608	7,879	.82	11,589	10,894	.94	330	209	.63
2000	31.22	26.02	23,217	22,852	1,089	904	.83	8,688	8,080	.93	11,835	12,900	1.09	1,240	1,333	1.07
2001	22.42	17.96	28,147	23,260	1,455	1,644	1.13	6,974	7,741	1.11	14,428	18,035	1.25	403	727	1.80
2002	27.73	25.57	23,516	23,207	1,348	1,375	1.02	5,638	5,356	.95	15,107	15,409	1.02	1,114	1,376	1.24

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Rice County (estimated mean soil permeability = 1.8 inches per hour)—Continued																
2003	24.01	21.96	28,993	22,801	1,054	1,423	1.35	3,085	3,579	1.16	17,581	22,504	1.28	1,081	1,487	1.38
Average	27.55	23.75	20,892	21,792	1,373	1,351	.97	12,670	11,234	.91	7,749	8,283	.99	596	661	1.11
p-value	.43	--	.03	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.54	--	1,161	237	--	--	--	--	--	--	--	--	--	--	--	--
Scott County (estimated mean soil permeability = 1.2 inches per hour)																
1991	21.53	18.07	89,217	66,737	62,014	82,479	1.33	1,575	2,000	1.27	NA	NA	NA	3,148	4,738	1.51
1992	22.29	17.62	68,154	60,801	57,975	65,512	1.13	1,614	1,614	1.00	352	197	.56	860	831	.97
1993	28.23	23.61	45,229	52,291	45,434	39,982	.88	3,020	2,325	.77	1,210	750	.62	2,627	2,172	.83
1994	18.59	15.55	68,869	58,816	48,409	56,639	1.17	2,701	3,052	1.13	2,354	2,260	.96	5,352	6,919	1.29
1995	17.69	17.03	66,414	61,306	44,264	50,018	1.13	5,973	6,451	1.08	3,371	2,865	.85	7,698	7,079	.92
1996	25.13	23.09	53,285	59,206	40,126	35,311	.88	7,685	6,763	.88	3,716	3,307	.89	7,679	7,905	1.03
1997	21.02	19.02	52,927	59,997	35,963	32,007	.89	7,441	6,027	.81	6,919	6,504	.94	9,674	8,389	.87
1998	18.41	15.13	52,090	60,720	29,596	26,932	.91	12,280	10,070	.82	6,413	5,323	.83	12,431	9,765	.79
1999	18.66	17.70	53,342	57,992	25,324	26,084	1.03	12,588	10,448	.83	9,724	7,390	.76	10,356	9,420	.91
2000	18.26	15.85	65,186	61,174	23,908	26,299	1.10	6,199	7,129	1.15	20,765	21,180	1.02	10,302	10,578	1.03
2001	17.80	16.04	51,564	58,450	19,041	18,279	.96	6,868	6,525	.95	21,034	19,562	.93	11,507	7,198	.63
2002	13.18	12.60	70,469	61,338	18,278	21,568	1.18	5,739	7,059	1.23	24,054	28,384	1.18	13,267	13,458	1.01
2003	16.95	16.09	61,369	59,597	17,237	17,926	1.04	5,158	5,622	1.09	25,985	25,205	.97	11,217	12,615	1.12
Average	19.83	17.49	61,393	59,879	35,967	38,387	1.05	6,065	5,776	1.00	10,491	10,244	.88	8,163	7,774	.95
p-value	.01	--	.43	.95	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.50	--	-589	-20	--	--	--	--	--	--	--	--	--	--	--	--
Sedgwick County (estimated mean soil permeability = 2.9 inches per hour)																
1991	25.40	20.54	42,425	35,420	13,912	17,807	1.28	18,450	21,771	1.18	NA	NA	NA	3,058	2,847	.93
1992	35.51	27.81	25,462	33,004	11,301	9,380	.83	18,529	12,970	.70	713	435	.61	2,461	2,677	1.09
1993	37.44	32.07	28,513	34,379	11,942	10,867	.91	19,256	15,020	.78	295	224	.76	2,886	2,402	.83
1994	25.82	21.34	37,948	35,423	12,498	14,498	1.16	18,823	19,199	1.02	585	509	.87	3,517	3,742	1.06
1995	36.38	34.55	30,594	36,317	12,471	10,974	.88	19,793	16,428	.83	1,117	525	.47	2,936	2,666	.91
1996	30.57	26.18	32,879	36,763	11,359	11,132	.98	22,039	18,733	.85	495	515	1.04	2,870	2,500	.87

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Sheridan County (estimated mean soil permeability = 1.3 inches per hour)																
1991	20.18	17.11	106,056	72,711	25,236	41,892	1.66	37,491	49,113	1.31	NA	NA	NA	9,984	15,051	1.51
1992	30.04	25.73	52,518	67,069	19,013	17,682	.93	30,634	21,750	.71	8,441	6,331	.75	8,981	6,755	.75
1993	33.03	28.77	37,556	67,138	16,780	12,082	.72	32,319	16,160	.50	11,920	6,556	.55	6,119	2,759	.45
1994	20.05	16.87	82,758	71,739	16,402	22,799	1.39	31,462	34,294	1.09	15,350	17,039	1.11	8,525	8,628	1.01
1995	23.66	22.65	85,854	71,711	14,580	20,120	1.38	31,471	36,821	1.17	17,075	18,953	1.11	8,585	9,959	1.16
1996	24.40	22.83	72,327	73,368	11,889	14,029	1.18	31,480	30,221	.96	18,485	16,821	.91	11,514	11,256	.98
1997	20.87	18.41	71,798	75,041	9,184	9,735	1.06	26,393	24,809	.94	29,963	27,566	.92	9,501	9,688	1.02
1998	20.49	16.15	71,006	74,876	6,906	8,011	1.16	21,180	19,909	.94	36,458	33,177	.91	10,332	9,909	.96
1999	22.37	21.42	62,029	75,310	5,637	5,468	.97	21,950	17,780	.81	35,215	28,524	.81	12,508	10,258	.82
2000	18.16	15.94	97,567	76,762	5,234	7,799	1.49	13,912	17,112	1.23	47,070	59,779	1.27	10,546	12,878	1.22
2001	22.60	19.86	81,265	74,168	3,197	3,900	1.22	11,416	12,558	1.10	48,340	52,207	1.08	11,215	12,600	1.12
2002	10.44	9.82	103,788	76,432	3,573	5,324	1.49	9,683	12,878	1.33	51,612	71,225	1.38	11,564	14,361	1.24
2003	13.86	12.83	98,120	77,645	2,475	3,539	1.43	10,072	12,187	1.21	54,668	69,975	1.28	10,430	12,418	1.19
Average	21.55	19.11	78,665	73,382	10,777	13,260	1.24	23,805	23,507	1.02	31,216	34,013	1.01	9,985	10,501	1.05
p-value	.06	--	.36	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-1.13	--	2,515	694	--	--	--	--	--	--	--	--	--	--	--	--
Sherman County (estimated mean soil permeability = 1.3 inches per hour)																
1991	23.24	20.39	134,181	107,024	40,720	63,608	1.56	59,639	62,064	1.04	--	--	--	6,665	8,509	1.28
1992	21.93	20.53	90,380	103,480	32,740	37,137	1.13	54,167	41,460	.77	11,002	7,417	.67	5,571	4,365	.78
1993	27.98	26.00	88,641	105,369	31,124	35,884	1.15	54,332	39,668	.73	13,784	8,666	.63	6,129	4,424	.72
1994	15.84	13.65	113,957	110,456	27,033	34,438	1.27	56,455	55,350	.98	18,095	16,771	.93	8,873	7,398	.83
1995	20.82	19.80	97,823	103,751	20,617	24,577	1.19	61,606	55,726	.90	13,782	11,795	.86	7,746	5,725	.74
1996	19.23	18.69	116,340	114,599	18,411	22,801	1.24	68,502	67,305	.98	19,045	17,518	.92	8,641	8,716	1.01
1997	18.67	16.44	132,015	116,825	15,828	20,067	1.27	44,234	46,913	1.06	50,580	58,426	1.16	6,183	6,609	1.07
1998	18.31	15.33	120,595	116,611	12,206	12,476	1.02	29,983	29,972	1.00	67,164	70,830	1.05	7,258	7,316	1.01
1999	20.29	19.27	104,481	114,015	9,419	9,949	1.06	24,774	20,925	.84	70,224	65,368	.93	9,598	8,240	.86
2000	16.82	15.17	142,948	115,596	7,048	10,592	1.50	18,452	22,779	1.23	83,083	101,880	1.23	7,013	7,696	1.10
2001	18.35	15.35	128,139	114,314	6,378	7,851	1.23	16,310	19,093	1.17	85,417	94,619	1.11	6,209	6,576	1.06
2002	11.02	10.43	156,184	115,501	4,869	7,897	1.62	15,946	22,470	1.41	88,097	117,703	1.34	6,589	8,114	1.23

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Sherman County (estimated mean soil permeability = 1.3 inches per hour)—Continued																
2003	14.70	13.98	144,636	116,603	4,182	5,762	1.38	14,268	17,991	1.26	91,727	113,302	1.24	6,426	7,582	1.18
Average	19.02	17.31	120,794	111,857	17,737	22,541	1.28	39,898	38,594	1.03	51,000	57,025	1.00	7,146	7,021	.99
p-value	0	--	.02	.02	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.69	--	4,699	1,054	--	--	--	--	--	--	--	--	--	--	--	--
Stafford County (estimated mean soil permeability = 6.3 inches per hour)																
1991	15.25	11.83	108,602	78,445	5,975	8,604	1.44	69,563	96,693	1.39	NA	NA	NA	2,907	3,305	1.14
1992	31.47	24.60	62,469	77,325	5,383	4,199	.78	65,646	53,830	.82	4,134	3,473	.84	2,162	968	.45
1993	38.73	32.67	50,492	76,489	5,103	3,776	.74	67,871	44,795	.66	1,212	582	.48	2,303	1,339	.58
1994	16.99	13.92	106,461	79,224	5,164	7,694	1.49	68,916	93,037	1.35	2,270	3,201	1.41	2,874	2,530	.88
1995	32.04	29.65	82,086	76,641	4,608	5,622	1.22	68,761	73,574	1.07	1,902	1,617	.85	1,370	1,273	.93
1996	26.49	23.80	71,546	79,422	4,738	4,359	.92	71,300	64,883	.91	1,781	1,389	.78	1,603	915	.57
1997	32.62	26.74	62,052	80,183	4,450	3,204	.72	54,868	43,346	.79	19,413	14,948	.77	1,452	554	.38
1998	27.99	21.66	89,716	81,781	3,760	4,286	1.14	44,075	47,601	1.08	31,638	35,751	1.13	2,308	2,077	.90
1999	29.86	26.10	80,130	82,256	3,540	3,469	.98	39,123	38,341	.98	36,855	36,486	.99	2,738	1,834	.67
2000	29.87	24.81	94,055	81,946	3,521	3,767	1.07	33,797	38,867	1.15	42,287	49,053	1.16	2,341	2,368	1.01
2001	25.52	21.36	100,190	82,397	3,582	4,155	1.16	28,050	33,941	1.21	48,613	59,794	1.23	2,152	2,301	1.07
2002	30.06	27.07	102,565	82,670	3,142	4,053	1.29	20,838	25,422	1.22	56,001	70,561	1.26	2,689	2,528	.94
2003	23.82	21.51	104,854	80,950	2,986	3,942	1.32	17,674	22,799	1.29	57,548	74,812	1.30	2,742	3,300	1.20
Average	27.75	23.52	85,786	79,979	4,304	4,702	1.10	50,037	52,087	1.07	25,305	29,306	1.02	2,280	1,946	.85
p-value	.85	--	.20	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.20	--	2,908	475	--	--	--	--	--	--	--	--	--	--	--	--
Stanton County (estimated mean soil permeability = 1.8 inches per hour)																
1991	18.22	15.20	236,953	151,971	92,302	148,606	1.61	32,928	47,416	1.44	NA	NA	NA	26,741	40,930	1.53
1992	15.37	12.46	221,141	151,103	88,751	134,902	1.52	28,737	41,669	1.45	2,056	2,262	1.10	31,559	42,309	1.34
1993	20.97	17.46	179,287	143,334	68,417	94,415	1.38	33,269	38,925	1.17	4,895	4,944	1.01	36,753	41,003	1.12
1994	17.04	15.49	198,112	140,109	51,219	77,853	1.52	31,465	39,961	1.27	16,858	24,613	1.46	40,567	55,686	1.37
1995	15.46	14.69	182,745	134,596	33,602	50,403	1.50	38,762	48,453	1.25	14,003	22,265	1.59	48,229	61,624	1.28
1996	23.91	22.85	156,832	130,683	32,998	42,567	1.29	36,219	39,117	1.08	18,296	23,968	1.31	43,170	51,180	1.19

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Stanton County (estimated mean soil permeability = 1.8 inches per hour)—Continued																
1997	19.72	17.90	145,945	135,102	25,567	31,959	1.25	29,475	28,886	0.98	32,000	35,520	1.11	48,060	49,581	1.03
1998	19.12	17.03	140,609	134,864	16,699	19,538	1.17	32,177	29,925	.93	42,147	43,833	1.04	43,841	47,314	1.08
1999	16.76	15.40	150,627	135,914	15,687	19,922	1.27	18,910	18,532	.98	55,320	59,746	1.08	45,997	52,427	1.14
2000	17.52	16.90	167,664	132,508	10,154	15,028	1.48	17,956	19,752	1.10	61,813	77,884	1.26	42,585	55,000	1.29
2001	19.54	17.17	125,333	127,360	6,235	7,295	1.17	14,520	13,213	.91	60,539	58,117	.96	46,066	46,707	1.01
2002	12.87	11.24	161,130	141,815	7,935	8,252	1.04	8,339	9,673	1.16	71,754	91,128	1.27	53,787	52,077	.97
2003	15.53	13.84	138,028	116,663	3,708	5,636	1.52	12,304	11,689	.95	63,049	75,659	1.20	37,602	45,044	1.20
Average	17.85	15.97	169,570	136,617	34,867	50,491	1.36	25,774	29,785	1.13	36,894	43,328	1.20	41,920	49,299	1.18
p-value	.50	--	0	.01	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.20	--	-7,520	-2,032	--	--	--	--	--	--	--	--	--	--	--	--
Stevens County (estimated mean soil permeability = 3.1 inches per hour)																
1991	23.33	19.47	235,817	137,515	47,441	87,291	1.84	62,747	105,415	1.68	NA	NA	NA	27,327	43,110	1.58
1992	14.85	11.48	225,734	140,364	41,411	74,540	1.80	55,380	89,716	1.62	6,812	8,106	1.19	36,761	53,372	1.45
1993	20.63	16.73	180,710	136,350	28,177	40,293	1.43	59,007	78,479	1.33	8,938	8,759	.98	40,228	53,178	1.32
1994	20.96	19.21	206,797	137,627	24,331	41,849	1.72	63,455	95,183	1.50	9,259	10,926	1.18	40,582	58,840	1.45
1995	13.04	12.01	209,056	140,006	21,394	36,798	1.72	70,212	101,807	1.45	7,600	9,956	1.31	40,800	60,495	1.48
1996	21.53	20.67	212,109	141,371	21,905	33,953	1.55	74,093	111,140	1.50	12,065	16,046	1.33	33,308	50,970	1.53
1997	20.66	17.74	207,239	156,542	16,252	25,678	1.58	66,646	87,973	1.32	39,026	48,783	1.25	34,618	44,805	1.29
1998	15.38	14.56	217,128	161,139	10,669	14,723	1.38	60,906	78,569	1.29	48,544	66,505	1.37	41,020	57,331	1.40
1999	19.47	17.83	197,888	169,084	8,550	11,457	1.34	50,380	56,929	1.13	73,410	88,092	1.20	36,744	41,410	1.13
2000	17.04	16.85	236,647	171,907	7,962	11,784	1.48	40,350	52,859	1.31	91,783	130,332	1.42	31,812	41,673	1.31
2001	15.04	12.42	210,617	168,675	6,018	7,161	1.19	32,731	40,259	1.23	103,016	131,860	1.28	26,910	31,336	1.16
2002	12.87	11.04	282,752	172,069	3,093	6,124	1.98	27,788	43,905	1.58	106,621	176,991	1.66	34,567	55,732	1.61
2003	24.81	23.76	203,187	171,049	3,461	4,603	1.33	22,124	26,991	1.22	119,410	139,710	1.17	26,054	31,883	1.22
Average	18.43	16.44	217,360	154,131	18,513	30,481	1.56	52,755	74,556	1.40	52,207	69,672	1.28	34,672	48,010	1.38
p-value	.43	--	.85	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.40	--	203	3,384	--	--	--	--	--	--	--	--	--	--	--	--

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Thomas County (estimated mean soil permeability = 1.3 inches per hour)																
1991	20.98	18.14	132,056	97,627	15,297	23,404	1.53	77,124	101,032	1.31	NA	NA	NA	5,206	7,619	1.46
1992	25.57	22.38	62,986	92,800	9,821	8,151	.83	62,032	40,321	.65	15,895	10,650	.67	5,052	3,864	.76
1993	29.74	26.23	71,509	95,163	9,346	9,066	.97	57,393	44,193	.77	23,332	14,699	.63	5,092	3,551	.70
1994	22.36	19.35	107,334	98,737	9,266	11,583	1.25	55,464	62,120	1.12	26,072	26,072	1.00	7,935	7,560	.95
1995	21.80	20.90	98,976	95,327	6,850	7,946	1.16	58,488	62,582	1.07	26,624	24,760	.93	3,365	3,687	1.10
1996	21.61	20.88	98,411	98,853	5,546	6,378	1.15	59,155	59,155	1.00	28,970	27,811	.96	5,182	5,067	.98
1997	20.97	18.52	109,941	99,975	5,227	6,272	1.20	37,263	40,989	1.10	51,926	56,080	1.08	5,559	6,599	1.19
1998	22.45	18.91	98,810	98,595	2,877	3,050	1.06	27,458	28,007	1.02	63,572	62,936	.99	4,688	4,817	1.03
1999	20.64	19.95	82,629	99,190	2,097	1,950	.93	24,760	21,294	.86	67,169	55,079	.82	5,164	4,306	.83
2000	16.32	14.35	133,946	101,694	1,721	2,513	1.46	19,756	26,473	1.34	73,269	96,715	1.32	6,948	8,245	1.19
2001	21.23	18.16	110,032	99,864	1,521	1,856	1.22	13,674	15,862	1.16	79,062	86,178	1.09	5,607	6,137	1.09
2002	12.69	12.19	135,487	101,526	1,285	1,953	1.52	11,547	14,780	1.28	82,751	110,886	1.34	5,943	7,868	1.32
2003	14.00	13.32	121,408	101,552	600	912	1.52	11,353	12,602	1.11	83,070	99,684	1.20	6,529	8,210	1.26
Average	20.80	18.71	104,887	98,531	5,496	6,541	1.22	39,651	40,724	1.06	51,809	55,963	1.00	5,559	5,964	1.07
p-value	.01	--	.08	0	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.85	--	3,402	580	--	--	--	--	--	--	--	--	--	--	--	--
Wallace County (estimated mean soil permeability = 1.4 inches per hour)																
1991	21.05	18.03	87,142	60,361	32,528	53,671	1.65	22,906	25,426	1.11	NA	NA	NA	4,927	8,045	1.63
1992	21.10	17.54	67,807	56,743	27,293	37,664	1.38	19,577	20,947	1.07	6,443	5,541	.86	3,430	3,654	1.07
1993	25.39	21.58	54,381	58,275	22,241	25,355	1.14	17,631	14,986	.85	11,897	8,447	.71	6,506	5,593	.86
1994	16.75	14.11	75,377	59,008	18,654	28,168	1.51	21,122	24,290	1.15	10,218	11,035	1.08	9,014	11,884	1.32
1995	22.37	21.22	68,972	57,233	16,133	25,167	1.56	21,451	21,022	.98	11,692	12,510	1.07	7,957	10,272	1.29
1996	18.87	18.23	80,443	61,595	17,533	30,157	1.72	19,540	21,494	1.10	16,733	18,406	1.10	7,789	10,386	1.33
1997	22.38	19.31	64,362	60,573	13,730	19,634	1.43	14,762	13,138	.89	23,696	22,037	.93	8,385	9,553	1.14
1998	18.09	15.63	66,462	60,573	10,491	13,428	1.28	12,587	12,209	.97	30,255	31,465	1.04	7,240	9,358	1.29
1999	24.81	23.88	59,611	60,660	7,772	9,326	1.20	11,834	9,941	.84	33,007	31,027	.94	8,047	9,317	1.16
2000	19.85	17.39	81,560	60,832	6,801	11,222	1.65	7,630	7,630	1.00	38,095	50,285	1.32	8,306	12,423	1.50
2001	15.98	13.15	70,014	59,998	5,740	8,954	1.56	8,270	8,187	.99	38,008	42,949	1.13	7,980	9,923	1.24

Table 1. Precipitation, irrigation water use, acres irrigated, irrigation application rate by system type, and soil permeability for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Precipitation data from Kansas State Climatologist (2005). Irrigation data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). Soil permeability from U.S. Department of Agriculture (1994). Blue shading indicates trend is significant at 95-percent confidence level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent confidence level ($p \leq 0.10$). acre-ft, acre-feet; acre-ft/acre, acre-feet per acre; NA, data not available; --, not computed]

Year	Annual precipitation (inches)	March–October precipitation (inches)	Total irrigation water use (acre-ft)	Total acres irrigated	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Wallace County (estimated mean soil permeability = 1.4 inches per hour)—Continued																
2002	13.49	12.28	84,891	59,227	4,784	8,563	1.79	5,916	6,981	1.18	37,957	53,140	1.40	10,570	16,207	1.53
2003	18.63	16.94	65,132	56,883	3,374	4,859	1.44	6,654	6,388	.96	39,859	45,041	1.13	6,996	8,845	1.26
Average	19.90	17.64	71,243	59,382	14,390	21,244	1.49	14,606	14,818	1.01	24,822	27,657	1.06	7,473	9,651	1.29
p-value	.16	--	1.0	.62	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.45	--	-.38	.36	--	--	--	--	--	--	--	--	--	--	--	--
Wichita County (estimated mean soil permeability = 1.2 inches per hour)																
1991	15.58	11.95	119,283	90,211	84,379	113,068	1.34	3,894	3,855	0.99	NA	NA	NA	1,938	2,360	1.22
1992	23.35	18.77	89,822	84,679	76,173	82,267	1.08	2,884	2,769	.96	353	124	.35	5,269	4,663	.89
1993	27.10	22.44	62,140	74,155	61,279	53,313	.87	4,486	3,185	.71	3,033	1,880	.62	5,357	3,762	.70
1994	19.34	17.29	89,985	80,031	60,342	68,790	1.14	5,696	6,095	1.07	8,174	8,746	1.07	5,819	6,355	1.09
1995	19.17	18.42	81,526	80,759	53,672	56,892	1.06	9,933	9,039	.91	7,221	7,221	1.00	9,933	8,374	.84
1996	19.13	17.75	78,341	79,777	47,274	48,692	1.03	14,353	12,631	.88	10,340	8,582	.83	7,810	8,436	1.08
1997	27.02	23.05	71,603	82,188	38,545	37,774	.98	15,922	11,145	.70	21,541	17,017	.79	6,180	5,666	.92
1998	18.96	15.85	68,012	77,496	30,928	28,454	.92	15,205	11,100	.73	22,943	22,255	.97	8,420	6,204	.74
1999	21.64	21.05	70,294	82,218	30,178	28,066	.93	12,602	9,830	.78	31,751	25,718	.81	7,687	6,681	.87
2000	20.62	18.85	86,257	83,347	26,326	28,169	1.07	11,686	10,050	.86	36,444	37,537	1.03	8,891	10,501	1.18
2001	19.82	17.46	62,082	75,350	19,986	17,788	.89	11,185	8,277	.74	36,345	28,713	.79	7,834	7,305	.93
2002	15.62	15.05	86,350	81,497	22,564	24,369	1.08	9,379	8,441	.90	36,845	39,793	1.08	12,709	13,747	1.08
2003	20.04	18.69	64,063	75,681	18,136	16,322	.90	5,593	3,580	.64	41,887	36,023	.86	10,065	8,138	.81
Average	20.57	18.20	79,212	80,568	43,829	46,459	1.02	9,448	7,692	.84	21,406	19,467	.85	7,532	7,092	.94
p-value	.67	--	.08	.36	--	--	--	--	--	--	--	--	--	--	--	--
slope	-.09	--	-2,723	.491	--	--	--	--	--	--	--	--	--	--	--	--

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Barton County																		
1991	2,737	3,722	1.36	11,359	16,016	1.41	3,206	3,623	1.13	1,840	2,668	1.45	1,055	580	0.55	17,711	24,264	1.37
1992	2,518	1,410	.56	11,687	8,064	.69	2,016	766	.38	2,083	1,062	.51	900	270	.30	13,304	8,648	.65
1993	2,377	1,046	.44	12,284	7,616	.62	2,215	952	.43	1,261	681	.54	259	111	.43	13,486	7,552	.56
1994	3,028	3,512	1.16	13,433	17,732	1.32	2,575	2,498	.97	2,691	3,471	1.29	336	373	1.11	13,362	16,168	1.21
1995	2,938	2,115	.72	10,971	11,629	1.06	3,207	2,437	.76	2,819	2,960	1.05	254	112	.44	15,815	14,234	.90
1996	2,897	2,231	.77	12,900	13,803	1.07	2,881	2,046	.71	2,106	2,064	.98	140	202	1.44	15,492	12,858	.83
1997	3,170	2,029	.64	12,678	10,396	.82	2,405	1,395	.58	3,697	2,218	.60	262	121	.46	14,183	8,793	.62
1998	3,354	2,884	.86	12,401	11,533	.93	1,855	1,187	.64	3,749	3,749	1.0	512	113	.22	14,364	10,773	.75
1999	3,240	1,976	.61	10,625	9,244	.87	1,763	1,075	.61	6,012	5,351	.89	203	37	.18	15,024	10,367	.69
2000	2,929	2,578	.88	11,556	12,249	1.06	1,683	1,532	.91	5,218	5,896	1.13	451	469	1.04	15,701	15,387	.98
2001	2,520	1,915	.76	10,693	13,152	1.23	1,606	1,799	1.12	6,650	7,714	1.16	869	547	.63	14,327	14,757	1.03
2002	4,075	3,953	.97	11,689	13,209	1.13	1,871	1,983	1.06	5,238	6,390	1.22	530	276	.52	14,801	14,357	.97
2003	4,455	4,188	.94	10,645	13,306	1.25	2,012	2,052	1.02	4,132	5,289	1.28	642	295	.46	15,789	17,684	1.12
Average	3,095	2,582	.82	11,763	12,150	1.04	2,253	1,796	.79	3,654	3,809	1.01	493	270	.60	14,874	13,526	.90
Cheyenne County																		
1991	3,072	4,454	1.45	16,491	24,242	1.47	1,949	1,813	.93	745	946	1.27	1,840	1,546	.84	19,882	23,063	1.16
1992	3,030	3,909	1.29	16,823	15,309	.91	2,560	3,021	1.18	780	593	.76	1,578	836	.53	17,443	15,873	.91
1993	3,206	3,623	1.13	20,150	22,770	1.13	531	446	.84	843	624	.74	2,077	1,558	.75	16,900	15,210	.90
1994	2,759	3,725	1.35	18,929	25,365	1.34	55	61	1.11	636	611	.96	1,635	1,439	.88	21,705	23,876	1.10
1995	3,165	3,450	1.09	14,046	16,855	1.20	160	170	1.06	567	425	.75	1,615	888	.55	23,251	18,833	.81
1996	3,422	3,388	.99	23,068	27,451	1.19	112	47	.42	130	74	.57	2,479	1,735	.70	17,526	16,299	.93
1997	3,537	4,068	1.15	24,188	33,379	1.38	80	67	.84	640	710	1.11	2,443	1,979	.81	17,606	19,367	1.10
1998	3,270	3,989	1.22	22,002	25,742	1.17	50	83	1.66	1,923	1,731	.90	792	475	.60	19,485	17,926	.92
1999	3,075	3,137	1.02	22,493	26,767	1.19	0	0	0	2,133	2,112	.99	1,543	756	.49	18,349	17,065	.93
2000	2,484	3,627	1.46	22,851	34,048	1.49	134	66	.49	1,793	2,492	1.39	1,642	1,067	.65	20,315	23,972	1.18
2001	2,543	3,331	1.31	17,744	22,003	1.24	890	1,077	1.21	2,926	2,955	1.01	1,841	939	.51	20,949	20,530	.98
2002	2,496	3,844	1.54	18,256	26,836	1.47	632	455	.72	2,769	4,237	1.53	880	572	.65	21,543	29,298	1.36
2003	2,391	3,300	1.38	13,936	19,928	1.43	1,314	1,472	1.12	2,415	3,429	1.42	3,811	2,973	.78	22,719	26,581	1.17
Average	2,958	3,680	1.26	19,306	24,669	1.28	651	675	.89	1,408	1,611	1.03	1,860	1,289	.67	19,821	20,607	1.03

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Edwards County																		
1991	15,697	23,389	1.49	39,844	59,368	1.49	2,359	2,878	1.22	9,371	12,932	1.38	4,315	3,323	0.77	23,247	32,778	1.41
1992	13,843	13,012	.94	48,574	42,259	.87	2,774	1,664	.60	5,925	4,740	.80	4,021	2,332	.58	19,664	15,535	.79
1993	12,876	9,271	.72	46,277	42,112	.91	1,108	565	.51	6,036	4,829	.80	2,183	677	.31	24,223	17,925	.74
1994	12,767	17,618	1.38	47,295	66,686	1.41	987	957	.97	8,387	10,316	1.23	1,427	1,241	.87	22,156	28,138	1.27
1995	12,844	14,000	1.09	47,498	57,473	1.21	716	630	.88	8,052	9,340	1.16	2,154	991	.46	21,571	22,218	1.03
1996	10,887	8,274	.76	55,345	45,936	.83	970	349	.36	8,684	5,905	.68	1,369	561	.41	17,636	13,932	.79
1997	13,425	11,948	.89	48,336	40,602	.84	1,304	600	.46	16,457	12,672	.77	1,314	394	.30	15,920	11,462	.72
1998	10,903	14,392	1.32	48,038	62,930	1.31	1,150	1,748	1.52	18,438	23,969	1.30	776	194	.25	18,666	23,146	1.24
1999	12,005	12,485	1.04	46,959	52,124	1.11	1,467	1,467	1.00	16,982	20,378	1.20	1,810	778	.43	20,842	21,676	1.04
2000	8,898	11,478	1.29	54,547	69,275	1.27	794	691	.87	18,118	24,097	1.33	1,490	894	.60	16,184	19,583	1.21
2001	9,773	12,509	1.28	50,421	67,060	1.33	1,115	702	.63	13,719	19,207	1.40	2,204	1,829	.83	22,554	26,163	1.16
2002	12,702	17,275	1.36	51,654	70,766	1.37	1,141	993	.87	12,272	17,672	1.44	2,598	1,819	.70	20,927	25,740	1.23
2003	12,289	14,624	1.19	45,524	62,823	1.38	1,828	1,408	.77	12,932	17,717	1.37	3,284	1,773	.54	24,670	29,357	1.19
Average	12,224	13,867	1.13	48,486	56,878	1.18	1,363	1,127	.82	11,952	14,136	1.14	2,227	1,293	.54	20,635	22,127	1.06
Finney County																		
1991	28,061	51,071	1.82	39,728	75,880	1.91	6,979	9,910	1.42	3,598	5,541	1.54	22,420	25,335	1.13	152,571	241,062	1.58
1992	27,788	41,126	1.48	42,285	65,119	1.54	5,052	4,395	.87	6,028	5,847	.97	24,885	27,871	1.12	144,156	145,598	1.01
1993	29,270	42,149	1.44	46,346	69,982	1.51	2,516	2,113	.84	2,855	2,912	1.02	21,049	19,786	.94	139,375	129,619	.93
1994	36,202	65,888	1.82	42,596	70,709	1.66	4,577	6,591	1.44	2,458	4,154	1.69	16,834	22,726	1.35	140,418	178,331	1.27
1995	37,740	59,629	1.58	49,436	76,626	1.55	3,220	3,478	1.08	1,857	2,563	1.38	13,060	10,840	.83	137,985	155,923	1.13
1996	33,362	49,709	1.49	60,964	89,007	1.46	1,994	1,236	.62	759	592	.78	9,966	7,973	.80	133,238	147,894	1.11
1997	38,902	62,243	1.60	61,271	85,167	1.39	2,438	2,072	.85	2,093	1,967	.94	10,614	9,765	.92	127,812	131,646	1.03
1998	42,314	70,664	1.67	60,268	87,389	1.45	1,137	796	.70	1,945	2,820	1.45	9,504	7,603	.80	125,788	125,788	1.0
1999	42,257	59,582	1.41	56,376	77,799	1.38	2,414	2,486	1.03	2,325	2,604	1.12	12,167	7,300	.60	126,095	113,486	.90
2000	37,547	71,339	1.90	55,670	93,526	1.68	1,174	845	.72	4,417	7,067	1.60	8,022	6,658	.83	129,450	142,395	1.10
2001	50,557	81,902	1.62	44,233	61,926	1.40	1,572	1,289	.82	6,989	11,392	1.63	13,890	11,251	.81	124,472	117,004	.94
2002	54,458	98,024	1.80	39,774	70,002	1.76	2,817	2,732	.97	6,997	12,595	1.80	9,842	9,251	.94	130,408	177,355	1.36
2003	50,167	82,776	1.65	35,070	53,657	1.53	4,020	4,543	1.13	8,304	13,536	1.63	9,018	8,477	.94	128,486	159,323	1.24
Average	39,125	64,316	1.64	48,771	75,138	1.56	3,070	3,268	.96	3,894	5,661	1.35	13,944	13,449	.92	133,866	151,186	1.12

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Ford County																		
1991	10,562	19,645	1.86	19,634	32,789	1.67	10,468	13,504	1.29	2,034	2,990	1.47	6,261	5,572	0.89	44,341	66,955	1.51
1992	10,366	14,098	1.36	20,819	23,942	1.15	11,533	9,572	.83	1,963	1,727	.88	5,165	3,512	.68	39,981	39,581	.99
1993	8,577	11,322	1.32	27,166	31,513	1.16	8,517	6,217	.73	1,219	939	.77	4,001	1,760	.44	39,543	36,775	.93
1994	8,133	13,419	1.65	31,065	43,180	1.39	5,461	4,423	.81	1,793	1,667	.93	5,061	2,834	.56	40,185	45,811	1.14
1995	7,529	11,068	1.47	33,583	41,979	1.25	4,262	3,921	.92	1,216	1,313	1.08	3,570	2,142	.60	39,494	39,889	1.01
1996	8,201	10,497	1.28	36,360	39,632	1.09	3,524	2,150	.61	1,819	982	.54	2,582	1,291	.50	36,861	27,646	.75
1997	6,996	10,284	1.47	41,947	38,172	.91	3,957	2,572	.65	962	789	.82	1,969	847	.43	31,107	21,775	.70
1998	7,240	11,584	1.60	39,793	50,935	1.28	1,616	1,293	.80	2,769	3,517	1.27	1,631	669	.41	33,659	31,976	.95
1999	6,439	9,272	1.44	37,258	40,984	1.10	1,537	999	.65	3,534	3,887	1.10	2,169	976	.45	36,673	33,372	.91
2000	5,766	9,283	1.61	39,375	51,975	1.32	1,158	753	.65	4,369	5,854	1.34	2,285	1,417	.62	37,403	35,533	.95
2001	6,345	10,723	1.69	34,810	44,905	1.29	1,607	1,286	.80	5,957	7,923	1.33	2,451	1,765	.72	40,306	41,112	1.02
2002	6,349	9,587	1.51	31,391	45,831	1.46	4,187	3,601	.86	5,687	7,848	1.38	2,008	1,667	.83	43,774	47,276	1.08
2003	6,552	9,042	1.38	28,767	38,835	1.35	5,143	4,474	.87	4,421	5,615	1.27	4,687	2,859	.61	40,459	37,627	.93
Average	7,620	11,525	1.51	32,459	40,359	1.26	4,844	4,213	.81	2,903	3,466	1.09	3,372	2,101	.60	38,753	38,871	.99
Graham County																		
1991	1,133	1,620	1.43	2,241	4,191	1.87	1,320	1,333	1.01	121	172	1.42	1,255	540	.43	6,269	7,774	1.24
1992	1,162	616	.53	1,487	1,130	.76	1,396	530	.38	430	576	1.34	900	306	.34	5,789	3,473	.60
1993	1,712	308	.18	3,201	1,921	.60	342	41	.12	125	23	.18	397	52	.13	3,111	778	.25
1994	1,656	1,275	.77	5,598	6,718	1.20	645	258	.40	50	40	.79	434	169	.39	2,929	1,816	.62
1995	1,451	1,146	.79	5,616	6,739	1.20	315	192	.61	0	0	0	822	288	.35	3,170	2,441	.77
1996	1,310	812	.62	7,132	6,918	.97	258	124	.48	0	0	0	898	314	.35	2,566	1,540	.60
1997	1,598	1,183	.74	7,721	8,416	1.09	274	55	.20	45	34	.76	547	164	.30	2,419	1,597	.66
1998	1,662	1,263	.76	8,934	8,666	.97	498	239	.48	127	98	.77	768	200	.26	1,775	1,065	.60
1999	1,559	1,060	.68	8,104	6,078	.75	303	33	.11	555	427	.77	819	278	.34	2,498	1,749	.70
2000	1,625	1,381	.85	8,215	9,283	1.13	245	164	.67	728	786	1.08	614	252	.41	3,163	2,815	.89
2001	2,174	1,891	.87	5,751	5,693	.99	495	203	.41	600	522	.87	649	208	.32	4,429	3,455	.78
2002	1,891	2,647	1.40	5,891	7,540	1.28	500	510	1.02	728	655	.90	822	238	.29	4,942	5,535	1.12
2003	2,204	2,182	.99	4,186	4,772	1.14	681	674	.99	733	931	1.27	1,402	771	.55	5,553	6,053	1.09
Average	1,626	1,337	.82	5,698	6,005	1.07	559	335	.53	326	328	.78	794	291	.34	3,739	3,084	.76

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Grant County																		
1991	8,614	18,089	2.10	7,769	15,538	20	1,586	2,236	1.41	4	5	1.13	3,862	4,364	1.13	120,203	195,931	1.63
1992	7,702	13,633	1.77	10,440	18,061	1.73	1,934	1,663	.86	0	0	0	3,584	4,767	1.33	120,226	174,328	1.45
1993	6,654	11,112	1.67	13,878	22,344	1.61	610	323	.53	162	183	1.13	2,959	2,042	.69	114,489	122,503	1.07
1994	5,127	9,741	1.90	13,000	24,440	1.88	362	442	1.22	0	0	0	2,938	2,204	.75	117,669	160,030	1.36
1995	5,375	10,428	1.94	12,513	22,774	1.82	396	693	1.75	0	0	0	1,831	1,996	1.09	116,090	150,917	1.30
1996	4,716	7,876	1.67	15,002	23,853	1.59	586	498	.85	0	0	0	1,904	1,809	.95	112,020	138,905	1.24
1997	5,865	9,149	1.56	16,471	21,906	1.33	470	334	.71	875	1,050	1.20	2,818	2,085	.74	111,204	110,092	.99
1998	5,975	10,456	1.75	16,257	23,898	1.47	290	55	.19	410	578	1.41	3,282	2,658	.81	108,769	105,506	.97
1999	5,816	8,724	1.50	20,423	31,043	1.52	874	507	.58	130	221	1.70	2,533	1,950	.77	100,790	101,798	1.01
2000	5,977	11,834	1.98	23,836	39,329	1.65	1,321	1,110	.84	245	453	1.85	2,601	1,743	.67	92,949	113,398	1.22
2001	5,441	8,216	1.51	19,417	27,572	1.42	1,187	985	.83	125	83	.66	6,834	3,622	.53	86,980	80,891	.93
2002	7,115	13,590	1.91	16,820	31,790	1.89	1,535	1,489	.97	0	0	0	3,260	2,119	.65	92,131	117,928	1.28
2003	7,882	13,557	1.72	16,022	26,597	1.66	2,690	1,883	.70	160	250	1.56	2,430	1,507	.62	88,048	100,375	1.14
Average	6,328	11,262	1.77	15,527	25,319	1.66	1,065	940	.88	162	217	.82	3,141	2,528	.83	106,274	128,662	1.20
Gray County																		
1991	24,592	51,397	2.09	34,239	66,766	1.95	11,566	16,077	1.39	2,576	3,916	1.52	19,224	19,801	1.03	105,455	160,292	1.52
1992	24,540	39,509	1.61	38,420	54,556	1.42	8,438	7,932	.94	1,444	1,473	1.02	16,723	15,552	.93	103,250	115,640	1.12
1993	24,287	35,702	1.47	47,071	66,841	1.42	7,559	5,820	.77	1,843	1,972	1.07	15,248	10,369	.68	91,741	89,906	.98
1994	22,098	38,672	1.75	49,379	81,969	1.66	5,196	5,092	.98	1,619	1,943	1.20	12,992	8,055	.62	98,573	120,259	1.22
1995	24,293	38,140	1.57	49,422	81,052	1.64	5,238	4,295	.82	1,406	1,982	1.41	11,792	7,547	.64	99,250	116,123	1.17
1996	24,329	31,871	1.31	60,893	82,814	1.36	4,484	3,139	.70	1,057	1,194	1.13	9,147	6,586	.72	88,358	91,892	1.04
1997	26,909	43,323	1.61	68,948	86,874	1.26	3,123	2,061	.66	1,649	1,847	1.12	9,363	7,022	.75	83,413	82,579	.99
1998	31,132	54,170	1.74	67,892	105,233	1.55	1,806	1,029	.57	3,804	5,097	1.34	7,460	5,371	.72	82,775	83,603	1.01
1999	32,171	43,109	1.34	69,099	89,829	1.30	1,741	1,027	.59	6,259	5,883	.94	7,714	4,011	.52	79,868	63,894	.80
2000	29,646	53,066	1.79	70,610	111,564	1.58	1,649	1,468	.89	6,488	8,953	1.38	6,725	3,430	.51	81,521	83,967	1.03
2001	33,119	56,633	1.71	62,654	90,848	1.45	1,758	1,565	.89	8,589	11,252	1.31	8,510	4,510	.53	78,428	77,644	.99
2002	33,009	59,746	1.81	57,248	100,184	1.75	2,778	2,778	10	6,990	10,415	1.49	8,665	5,199	.60	76,036	89,722	1.18
2003	32,408	53,797	1.66	47,618	75,236	1.58	5,831	5,423	.93	6,744	8,970	1.33	11,531	7,610	.66	77,294	82,705	1.07
Average	27,887	46,087	1.65	55,653	84,136	1.53	4,705	4,439	.86	3,882	4,992	1.25	11,161	8,082	.69	88,151	96,787	1.09

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Greeley County																		
1991	7	7	1.01	11,588	18,541	1.60	567	1,083	1.91	0	0	0	497	527	1.06	14,552	19,645	1.35
1992	102	165	1.62	15,152	19,849	1.31	312	222	.71	0	0	0	940	620	.66	11,841	13,262	1.12
1993	0	0	0	14,531	16,711	1.15	430	228	.53	0	0	0	122	48	.39	11,791	11,909	1.01
1994	245	169	.69	14,774	20,684	1.40	506	476	.94	120	122	1.02	555	261	.47	10,844	13,013	1.20
1995	120	202	1.68	14,927	15,524	1.04	80	82	1.03	0	0	0	358	372	1.04	12,544	12,042	.96
1996	245	250	1.02	15,967	19,160	1.20	580	238	.41	0	0	0	673	478	.71	12,278	12,278	1.0
1997	245	262	1.07	16,944	17,113	1.01	119	88	.74	120	82	.68	808	493	.61	10,761	10,115	.94
1998	476	457	.96	17,253	16,045	.93	60	65	1.08	135	173	1.28	490	108	.22	11,953	11,116	.93
1999	477	582	1.22	16,069	15,908	.99	314	195	.62	125	128	1.02	550	17	.03	12,205	9,398	.77
2000	519	862	1.66	14,210	16,484	1.16	353	441	1.25	115	16	.14	728	546	.75	13,526	13,526	1.0
2001	350	648	1.85	9,444	11,616	1.23	979	920	.94	0	0	0	925	453	.49	16,766	14,419	.86
2002	599	1,174	1.96	9,021	12,900	1.43	466	489	1.05	0	0	0	1,315	1,328	1.01	17,860	17,860	1.0
2003	377	622	1.65	4,581	6,184	1.35	490	358	.73	125	15	.12	1,356	746	.55	21,509	20,649	.96
Average	289	415	1.26	13,420	15,902	1.22	404	376	.92	57	41	.33	717	461	.61	13,725	13,787	1.01
Harvey County																		
1991	124	77	.62	5,878	8,053	1.37	1,330	1,011	.76	2,941	3,176	1.08	392	318	.81	16,672	20,006	1.20
1992	188	107	.57	4,847	3,296	.68	1,907	1,201	.63	2,796	2,125	.76	131	97	.74	16,342	11,766	.72
1993	163	64	.39	4,506	3,289	.73	798	279	.35	2,698	2,050	.76	0	0	0	17,204	11,183	.65
1994	411	469	1.14	4,569	5,391	1.18	1,006	865	.86	4,372	4,591	1.05	22	2	.08	16,498	17,818	1.08
1995	103	131	1.27	5,048	5,199	1.03	2,252	1,689	.75	3,575	3,146	.88	300	78	.26	16,423	14,452	.88
1996	46	15	.32	6,324	6,830	1.08	1,376	963	.70	3,416	2,938	.86	218	76	.35	17,480	14,159	.81
1997	130	243	1.87	7,201	5,689	.79	734	477	.65	3,892	2,685	.69	272	71	.26	17,161	12,184	.71
1998	410	533	1.30	6,882	6,676	.97	629	346	.55	4,893	4,306	.88	27	8	.30	17,285	15,557	.90
1999	30	8	.25	7,547	5,736	.76	612	306	.50	6,354	4,893	.77	67	7	.11	15,390	12,312	.80
2000	30	11	.37	6,461	5,944	.92	532	399	.75	7,958	8,674	1.09	60	3	.05	16,391	15,571	.95
2001	0	0	0	7,053	8,252	1.17	869	626	.72	6,872	8,040	1.17	200	204	1.02	16,187	18,615	1.15
2002	20	9	.44	8,154	9,051	1.11	591	349	.59	6,346	6,663	1.05	0	0	0	16,733	17,235	1.03
2003	89	72	.81	10,606	13,045	1.23	1,688	1,148	.68	4,954	5,449	1.10	60	1	.01	15,565	17,744	1.14
Average	134	134	.72	6,544	6,650	1.0	1,102	743	.65	4,697	4,518	.93	135	66	.31	16,564	15,277	.92

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Haskell County																		
1991	2,607	4,693	1.80	26,811	54,963	2.05	3,146	5,380	1.71	517	822	1.59	6,260	7,387	1.18	179,325	317,405	1.77
1992	1,977	3,045	1.54	29,427	50,909	1.73	1,940	2,076	1.07	381	431	1.13	5,285	5,549	1.05	178,235	269,135	1.51
1993	1,912	3,117	1.63	36,131	62,145	1.72	325	146	.45	470	602	1.28	7,116	6,262	.88	170,624	208,161	1.22
1994	2,223	3,201	1.44	37,060	68,932	1.86	535	514	.96	735	1,029	1.40	6,344	7,803	1.23	171,191	256,787	1.50
1995	2,243	3,409	1.52	38,254	66,179	1.73	210	271	1.29	230	350	1.52	5,989	5,749	.96	166,383	246,247	1.48
1996	1,925	2,464	1.28	42,659	61,856	1.45	270	348	1.29	325	198	.61	3,280	3,870	1.18	163,841	214,632	1.31
1997	2,220	3,064	1.38	53,421	75,858	1.42	1,458	1,108	.76	425	531	1.25	2,083	1,458	.70	153,809	184,571	1.20
1998	2,523	3,785	1.50	59,138	88,116	1.49	0	0	0	1,005	1,417	1.41	2,280	1,915	.84	149,463	164,409	1.10
1999	2,037	2,913	1.43	59,992	79,189	1.32	124	100	.81	2,444	2,591	1.06	2,693	1,912	.71	145,584	144,128	.99
2000	1,934	3,249	1.68	62,158	99,453	1.60	0	0	0	3,396	4,415	1.30	2,977	2,382	.80	139,650	166,184	1.19
2001	2,490	3,461	1.39	60,180	85,456	1.42	0	0	0	3,118	4,459	1.43	1,982	1,368	.69	132,710	145,981	1.10
2002	5,981	10,168	1.70	56,574	95,044	1.68	1,376	1,459	1.06	1,424	2,278	1.60	1,328	1,049	.79	146,718	193,668	1.32
2003	6,353	11,054	1.74	48,045	72,068	1.50	1,979	2,870	1.45	1,903	2,303	1.21	1,928	1,832	.95	139,745	159,309	1.14
Average	2,802	4,432	1.54	46,912	73,859	1.61	874	1,098	.83	1,259	1,648	1.29	3,811	3,734	.92	156,714	205,432	1.29
Kearny County																		
1991	20,647	43,565	2.11	17,282	32,317	1.87	1,736	2,899	1.67	405	595	1.47	4,447	4,358	.98	54,061	84,335	1.56
1992	18,360	34,884	1.90	21,649	33,772	1.56	1,103	1,004	.91	259	347	1.34	4,696	5,119	1.09	51,699	58,420	1.13
1993	18,441	34,116	1.85	24,078	37,080	1.54	1,776	1,279	.72	0	0	0	3,953	3,202	.81	50,113	49,612	.99
1994	20,325	40,447	1.99	23,535	40,716	1.73	1,175	1,575	1.34	130	283	2.18	2,976	2,887	.97	49,730	63,654	1.28
1995	22,428	40,595	1.81	20,336	34,978	1.72	788	630	.80	0	0	0	2,689	1,963	.73	49,822	51,317	1.03
1996	21,517	37,224	1.73	27,406	41,657	1.52	509	448	.88	0	0	0	1,691	1,048	.62	45,881	51,387	1.12
1997	24,356	43,597	1.79	30,368	43,123	1.42	275	146	.53	0	0	0	1,833	990	.54	47,340	44,026	.93
1998	26,995	49,131	1.82	32,017	41,622	1.30	0	0	0	550	798	1.45	1,004	562	.56	43,253	39,793	.92
1999	23,254	39,299	1.69	34,932	49,603	1.42	152	214	1.41	380	464	1.22	1,119	705	.63	43,213	43,645	1.01
2000	24,783	51,301	2.07	35,429	58,104	1.64	680	932	1.37	1,133	1,835	1.62	1,941	1,863	.96	39,251	47,494	1.21
2001	28,477	51,543	1.81	24,025	31,473	1.31	510	372	.73	1,148	1,940	1.69	4,082	2,163	.53	42,869	44,584	1.04
2002	34,244	72,255	2.11	24,268	42,954	1.77	235	362	1.54	1,326	2,254	1.70	985	1,251	1.27	46,217	66,552	1.44
2003	32,457	61,019	1.88	20,351	30,527	1.50	695	813	1.17	824	1,211	1.47	1,676	922	.55	47,843	52,149	1.09
Average	24,330	46,075	1.89	25,821	39,840	1.56	741	821	1.01	473	748	1.09	2,546	2,079	.79	47,022	53,613	1.13

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Kiowa County																		
1991	8,274	12,659	1.53	14,358	23,978	1.67	1,795	2,100	1.17	4,412	6,794	1.54	1,412	890	0.63	18,963	28,824	1.52
1992	5,735	6,079	1.06	19,562	19,758	1.01	1,202	889	.74	3,785	3,671	.97	1,202	553	.46	17,397	16,179	.93
1993	5,413	4,926	.91	19,918	23,902	1.20	687	357	.52	4,584	5,226	1.14	844	279	.33	17,113	17,113	1.0
1994	5,618	7,528	1.34	19,414	28,150	1.45	962	875	.91	4,421	6,234	1.41	390	133	.34	18,007	23,949	1.33
1995	4,510	4,059	.90	20,000	26,000	1.30	832	874	1.05	3,501	4,691	1.34	1,668	634	.38	18,173	19,627	1.08
1996	4,930	4,141	.84	24,118	24,600	1.02	439	206	.47	4,510	3,563	.79	638	236	.37	16,037	13,150	.82
1997	4,175	2,964	.71	23,067	22,144	.96	537	397	.74	7,452	6,632	.89	730	380	.52	15,404	11,861	.77
1998	3,310	4,535	1.37	23,104	33,501	1.45	130	78	.60	9,201	12,329	1.34	990	347	.35	15,117	18,443	1.22
1999	3,779	3,817	1.01	20,562	25,291	1.23	240	230	.96	10,197	13,154	1.29	2,064	991	.48	15,181	16,244	1.07
2000	3,733	4,666	1.25	20,862	27,121	1.30	130	104	.80	8,431	10,792	1.28	2,250	1,508	.67	16,446	19,900	1.21
2001	4,605	6,447	1.40	20,624	30,524	1.48	528	517	.98	7,976	11,964	1.50	1,473	737	.50	16,333	20,416	1.25
2002	5,262	7,419	1.41	24,057	34,402	1.43	922	821	.89	7,132	9,700	1.36	899	396	.44	14,579	16,328	1.12
2003	5,122	6,351	1.24	23,924	34,211	1.43	1,682	1,732	1.03	5,531	7,633	1.38	971	573	.59	15,399	16,939	1.10
Average	4,959	5,815	1.15	21,044	27,199	1.30	776	706	.84	6,241	7,876	1.25	1,195	589	.47	16,473	18,383	1.11
Lane County																		
1991	98	90	.92	2,478	4,039	1.63	517	729	1.41	0	0	0	588	612	1.04	20,746	22,198	1.07
1992	559	347	.62	2,637	3,244	1.23	758	561	.74	0	0	0	593	362	.61	15,717	12,102	.77
1993	100	139	1.39	4,244	4,456	1.05	210	90	.43	0	0	0	409	299	.73	12,117	6,180	.51
1994	0	0	0	4,478	5,821	1.30	206	173	.84	0	0	0	236	184	.78	13,570	13,841	1.02
1995	0	0	0	5,664	6,230	1.10	392	396	1.01	0	0	0	258	289	1.12	15,391	14,160	.92
1996	123	68	.55	7,309	6,578	.90	487	253	.52	0	0	0	192	52	.27	13,119	8,396	.64
1997	120	64	.53	5,971	4,717	.79	248	117	.47	0	0	0	483	256	.53	14,623	9,797	.67
1998	120	106	.88	5,648	5,083	.90	111	89	.80	431	315	.73	244	46	.19	15,741	9,445	.60
1999	196	102	.52	4,293	3,778	.88	417	463	1.11	32	40	1.24	323	152	.47	17,901	12,173	.68
2000	0	0	0	5,572	5,182	.93	448	327	.73	835	785	.94	410	209	.51	15,647	12,361	.79
2001	123	154	1.25	2,549	2,600	1.02	733	462	.63	544	435	.80	54	29	.54	15,504	13,178	.85
2002	248	337	1.36	1,499	2,189	1.46	797	948	1.19	546	519	.95	244	271	1.11	15,631	14,224	.91
2003	120	188	1.57	1,775	2,112	1.19	400	372	.93	208	154	.74	1,010	525	.52	16,624	17,621	1.06
Average	139	123	.74	4,163	4,310	1.11	440	383	.83	200	173	.42	388	253	.65	15,564	12,744	.81

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
McPherson County																		
1991	493	611	1.24	5,505	7,212	1.31	1,980	1,445	.73	2,859	3,088	1.08	111	151	1.36	19,487	24,359	1.25
1992	523	220	.42	5,622	2,249	.40	1,418	510	.36	2,812	1,097	.39	128	64	.50	17,396	8,176	.47
1993	294	74	.25	5,451	2,671	.49	871	174	.20	2,566	1,257	.49	138	3	.02	15,789	8,210	.52
1994	353	219	.62	6,392	7,479	1.17	1,020	479	.47	3,051	2,959	.97	0	0	0	18,716	19,277	1.03
1995	403	97	.24	5,591	5,144	.92	1,079	615	.57	3,349	2,813	.84	270	62	.23	17,525	15,072	.86
1996	196	139	.71	7,404	6,812	.92	680	333	.49	3,658	2,231	.61	316	44	.14	18,468	14,590	.79
1997	140	50	.36	7,075	5,306	.75	851	408	.48	5,863	3,811	.65	316	28	.09	17,210	12,563	.73
1998	180	74	.41	8,718	6,887	.79	945	473	.50	5,863	5,453	.93	318	146	.46	16,700	14,362	.86
1999	288	271	.94	7,513	4,207	.56	339	264	.78	7,416	4,969	.67	143	31	.22	16,862	10,623	.63
2000	224	105	.47	7,476	5,607	.75	493	424	.86	6,966	6,269	.90	143	19	.13	17,786	16,363	.92
2001	187	101	.54	7,491	7,116	.95	610	482	.79	6,987	7,616	1.09	393	67	.17	17,601	17,777	1.01
2002	846	601	.71	8,291	8,788	1.06	1,282	1,231	.96	7,168	7,455	1.04	24	25	1.04	16,937	17,276	1.02
2003	550	319	.58	11,090	12,421	1.12	948	853	.90	6,007	8,049	1.34	0	0	0	15,393	17,394	1.13
Average	360	222	.58	7,201	6,300	.86	963	592	.62	4,967	4,390	.85	177	49	.34	17,375	15,080	.86
Meade County																		
1991	685	795	1.16	9,910	19,424	1.96	5,089	9,466	1.86	260	351	1.35	3,469	4,857	1.40	105,371	181,238	1.72
1992	397	202	.51	17,480	25,870	1.48	4,036	4,722	1.17	355	277	.78	3,364	2,658	.79	97,920	135,130	1.38
1993	834	892	1.07	20,583	33,139	1.61	1,925	1,867	.97	250	103	.41	2,379	1,808	.76	98,471	124,073	1.26
1994	1,390	1,432	1.03	28,763	48,034	1.67	890	1,068	1.20	0	0	0	1,985	1,429	.72	89,818	130,236	1.45
1995	1,997	2,736	1.37	22,521	38,736	1.72	2,356	2,285	.97	0	0	0	1,070	1,380	1.29	91,310	128,747	1.41
1996	1,660	1,710	1.03	26,951	42,044	1.56	1,935	2,032	1.05	205	176	.86	1,025	646	.63	93,017	119,992	1.29
1997	2,320	1,879	.81	30,012	41,417	1.38	2,020	1,959	.97	505	833	1.65	1,188	190	.16	88,354	98,073	1.11
1998	2,466	2,984	1.21	39,537	63,655	1.61	835	443	.53	485	475	.98	1,332	1,678	1.26	80,071	101,690	1.27
1999	1,861	1,991	1.07	43,267	55,382	1.28	177	156	.88	1,059	1,387	1.31	1,958	1,547	.79	78,498	81,638	1.04
2000	2,452	3,335	1.36	46,343	72,295	1.56	1,165	1,433	1.23	788	1,174	1.49	1,777	1,670	.94	75,811	100,071	1.32
2001	2,842	3,666	1.29	43,666	66,809	1.53	880	933	1.06	1,352	2,339	1.73	2,062	2,103	1.02	68,185	84,549	1.24
2002	2,593	4,071	1.57	43,450	80,817	1.86	1,382	1,520	1.10	744	1,354	1.82	1,779	1,388	.78	75,942	112,394	1.48
2003	3,147	3,147	1.0	42,141	65,319	1.55	1,929	1,659	.86	1,587	1,841	1.16	2,486	1,666	.67	70,939	82,999	1.17
Average	1,896	2,218	1.11	31,894	50,226	1.60	1,894	2,273	1.07	584	793	1.04	1,990	1,771	.86	85,670	113,910	1.32

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Morton County																		
1991	2,017	4,135	2.05	1,544	2,964	1.92	1,449	2,029	1.40	0	0	0	1,847	2,235	1.21	43,921	72,470	1.65
1992	1,279	2,468	1.93	3,266	5,422	1.66	1,674	2,411	1.44	0	0	0	1,427	1,969	1.38	42,002	61,743	1.47
1993	1,593	2,788	1.75	2,634	3,424	1.30	313	291	.93	0	0	0	1,158	648	.56	47,327	60,105	1.27
1994	1,568	2,885	1.84	2,596	3,349	1.29	947	578	.61	0	0	0	1,876	1,313	.70	45,136	57,774	1.28
1995	1,247	1,958	1.57	4,191	5,951	1.42	885	770	.87	0	0	0	1,117	1,229	1.10	42,184	50,621	1.20
1996	981	1,334	1.36	3,050	4,667	1.53	1,490	581	.39	0	0	0	1,721	1,790	1.04	44,966	47,664	1.06
1997	1,123	1,595	1.42	5,001	6,401	1.28	1,358	1,304	.96	0	0	0	1,633	1,486	.91	41,850	42,687	1.02
1998	1,243	2,175	1.75	6,971	9,550	1.37	704	704	1.0	0	0	0	1,894	1,818	.96	39,112	40,285	1.03
1999	1,044	1,691	1.62	8,040	9,326	1.16	720	518	.72	45	48	1.07	2,106	1,474	.70	40,505	35,239	.87
2000	614	1,124	1.83	9,138	12,610	1.38	1,275	956	.75	607	680	1.12	3,057	2,782	.91	35,856	37,290	1.04
2001	915	1,812	1.98	7,981	8,220	1.03	1,393	919	.66	113	96	.85	4,469	3,799	.85	32,715	29,444	.90
2002	364	535	1.47	7,440	9,821	1.32	1,621	1,459	.90	0	0	0	4,407	4,143	.94	28,574	34,003	1.19
2003	303	648	2.14	6,373	6,500	1.02	1,997	1,058	.53	0	0	0	4,023	2,414	.60	30,090	28,886	.96
Average	1,099	1,934	1.75	5,248	6,785	1.36	1,217	1,044	.86	59	63	.23	2,364	2,085	.91	39,557	46,016	1.15
Pawnee County																		
1991	9,150	12,810	1.40	11,623	16,040	1.38	5,499	6,819	1.24	4,507	6,039	1.34	2,469	2,099	.85	43,837	63,125	1.44
1992	8,854	7,614	.86	14,797	10,950	.74	6,055	2,604	.43	3,568	2,391	.67	4,982	2,939	.59	32,280	19,045	.59
1993	9,477	5,118	.54	17,720	10,100	.57	4,866	1,557	.32	4,061	1,827	.45	3,161	1,075	.34	25,069	11,532	.46
1994	9,303	12,745	1.37	18,441	24,158	1.31	4,211	4,127	.98	4,386	5,483	1.25	2,766	1,909	.69	35,415	42,144	1.19
1995	8,860	8,151	.92	19,554	22,878	1.17	6,028	4,220	.70	4,746	4,366	.92	2,378	927	.39	36,010	34,570	.96
1996	9,210	6,908	.75	18,939	15,719	.83	6,156	3,817	.62	4,696	3,475	.74	1,495	568	.38	33,876	22,697	.67
1997	8,053	6,120	.76	17,284	13,309	.77	4,499	2,429	.54	8,161	6,039	.74	1,092	491	.45	36,414	25,126	.69
1998	9,461	10,123	1.07	20,741	21,363	1.03	3,119	1,653	.53	7,574	6,817	.90	649	487	.75	39,056	37,103	.95
1999	9,337	8,030	.86	22,017	18,274	.83	1,838	1,507	.82	9,271	8,158	.88	1,079	550	.51	36,593	31,104	.85
2000	8,771	10,262	1.17	21,894	23,208	1.06	1,919	1,401	.73	9,911	11,299	1.14	783	180	.23	35,937	38,453	1.07
2001	8,977	10,324	1.15	21,468	22,327	1.04	2,135	1,900	.89	9,736	11,002	1.13	1,147	963	.84	36,071	36,432	1.01
2002	11,706	14,515	1.24	22,451	29,411	1.31	2,081	2,123	1.02	9,366	11,614	1.24	1,729	1,089	.63	32,179	36,040	1.12
2003	11,847	12,439	1.05	19,504	23,795	1.22	3,265	2,971	.91	8,741	11,188	1.28	3,363	1,816	.54	28,192	31,011	1.10
Average	9,462	9,628	1.01	18,956	19,349	1.02	3,975	2,856	.75	6,825	6,900	.98	2,084	1,161	.55	34,687	32,952	.93

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Pratt County																		
1991	7,019	9,335	1.33	35,052	50,475	1.44	2,821	3,272	1.16	3,858	5,208	1.35	2,642	1,506	0.57	20,264	27,964	1.38
1992	6,798	6,118	.90	38,122	35,453	.93	1,568	1,223	.78	2,412	1,930	.80	1,461	774	.53	20,063	16,652	.83
1993	6,613	5,621	.85	40,588	41,806	1.03	933	634	.68	3,135	3,041	.97	1,245	448	.36	18,430	16,771	.91
1994	6,901	9,730	1.41	40,673	60,603	1.49	645	703	1.09	4,638	6,725	1.45	1,666	1,666	1.0	16,675	22,845	1.37
1995	7,135	6,636	.93	38,489	48,881	1.27	163	139	.85	4,478	5,194	1.16	1,950	839	.43	18,686	20,368	1.09
1996	5,268	4,636	.88	43,696	45,007	1.03	604	399	.66	4,897	3,673	.75	701	379	.54	16,185	14,728	.91
1997	3,746	1,910	.51	46,455	39,022	.84	369	122	.33	6,202	4,838	.78	887	319	.36	15,472	11,759	.76
1998	3,365	3,500	1.04	45,912	58,308	1.27	255	423	1.66	9,876	11,950	1.21	1,809	651	.36	14,088	17,469	1.24
1999	2,621	2,385	.91	48,077	58,654	1.22	747	620	.83	10,761	12,806	1.19	2,518	1,259	.50	15,509	16,905	1.09
2000	2,203	2,379	1.08	48,267	54,059	1.12	636	623	.98	11,974	14,608	1.22	2,192	1,381	.63	16,442	18,251	1.11
2001	2,873	3,361	1.17	42,999	59,769	1.39	764	665	.87	12,290	17,821	1.45	2,195	1,098	.50	21,338	26,886	1.26
2002	4,145	5,098	1.23	42,827	54,819	1.28	508	483	.95	10,138	12,774	1.26	2,067	1,075	.52	23,922	25,118	1.05
2003	5,117	5,987	1.17	45,880	66,067	1.44	2,361	2,408	1.02	7,736	10,057	1.30	1,733	763	.44	21,364	24,996	1.17
Average	4,908	5,131	1.03	42,849	51,763	1.21	952	901	.91	7,107	8,510	1.15	1,774	935	.52	18,341	20,055	1.09
Rawlins County																		
1991	2,011	2,192	1.09	4,355	5,662	1.30	1,582	1,962	1.24	170	83	.49	593	551	.93	7,686	8,762	1.14
1992	2,006	1,585	.79	4,082	2,612	.64	2,393	861	.36	206	97	.47	323	255	.79	5,743	3,905	.68
1993	2,234	1,296	.58	4,993	3,795	.76	967	367	.38	308	92	.30	366	183	.50	6,432	5,210	.81
1994	2,310	1,756	.76	5,322	6,120	1.15	606	351	.58	122	95	.78	725	312	.43	8,824	7,236	.82
1995	2,591	2,202	.85	4,895	6,070	1.24	545	480	.88	265	183	.69	559	492	.88	10,438	7,202	.69
1996	2,055	1,582	.77	8,669	7,369	.85	556	389	.70	0	0	0	631	391	.62	5,334	3,894	.73
1997	2,533	2,204	.87	9,181	11,017	1.20	471	495	1.05	122	106	.87	538	420	.78	5,087	5,138	1.01
1998	2,681	2,198	.82	7,536	8,139	1.08	245	147	.60	245	181	.74	159	56	.35	7,038	5,490	.78
1999	2,310	1,409	.61	7,069	6,503	.92	337	189	.56	480	274	.57	1,031	557	.54	6,061	4,061	.67
2000	2,082	2,373	1.14	7,635	10,994	1.44	19	10	.51	161	233	1.45	1,014	619	.61	7,348	8,891	1.21
2001	1,953	1,582	.81	5,929	6,996	1.18	445	334	.75	758	841	1.11	1,045	387	.37	7,865	5,899	.75
2002	2,570	2,776	1.08	5,669	7,596	1.34	440	418	.95	1,021	1,623	1.59	717	445	.62	8,682	10,418	1.20
2003	2,508	2,433	.97	3,584	4,516	1.26	483	290	.60	591	786	1.33	2,035	1,323	.65	9,909	10,107	1.02
Average	2,296	1,968	.86	6,071	6,722	1.10	699	484	.70	342	354	.80	749	461	.62	7,419	6,632	.89

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Reno County																		
1991	1,662	2,044	1.23	11,266	14,758	1.31	3,141	2,419	0.77	2,694	3,098	1.15	485	291	0.60	14,507	15,522	1.07
1992	1,474	811	.55	10,800	7,992	.74	3,578	1,825	.51	3,034	2,184	.72	414	128	.31	12,699	7,492	.59
1993	1,470	882	.60	11,385	8,880	.78	2,819	1,494	.53	2,578	1,779	.69	753	113	.15	12,544	7,903	.63
1994	1,355	1,721	1.27	9,820	11,686	1.19	1,971	1,892	.96	3,720	4,129	1.11	477	91	.19	15,889	15,253	.96
1995	1,395	809	.58	8,112	8,680	1.07	2,439	2,073	.85	3,841	3,803	.99	296	50	.17	17,081	14,006	.82
1996	1,974	1,461	.74	11,898	12,612	1.06	2,952	1,948	.66	4,613	4,152	.90	628	220	.35	14,858	11,144	.75
1997	1,788	930	.52	12,865	10,935	.85	2,103	1,073	.51	7,385	5,686	.77	825	281	.34	13,195	8,709	.66
1998	1,870	1,739	.93	13,194	14,777	1.12	1,667	1,367	.82	9,519	11,613	1.22	615	178	.29	13,398	11,656	.87
1999	1,650	1,320	.80	15,085	14,632	.97	1,704	1,005	.59	12,751	12,113	.95	547	159	.29	12,564	9,046	.72
2000	1,019	1,202	1.18	14,224	15,362	1.08	1,201	925	.77	15,746	19,053	1.21	506	207	.41	11,936	11,936	1.0
2001	1,515	1,364	.90	16,207	18,800	1.16	1,415	1,330	.94	12,546	15,808	1.26	857	583	.68	13,585	15,759	1.16
2002	1,361	1,429	1.05	15,964	17,720	1.11	1,938	1,492	.77	12,124	13,700	1.13	578	249	.43	15,708	14,766	.94
2003	1,751	1,348	.77	18,262	23,193	1.27	3,353	4,024	1.20	9,524	11,715	1.23	996	797	.80	13,880	14,296	1.03
Average	1,560	1,312	.86	13,006	13,848	1.05	2,329	1,759	.76	7,698	8,372	1.03	614	257	.39	13,988	12,115	.86
Rice County																		
1991	392	561	1.43	9,598	12,861	1.34	811	697	.86	1,583	1,884	1.19	60	50	.83	8,738	11,359	1.30
1992	486	214	.44	9,952	4,976	.50	1,495	583	.39	932	457	.49	163	52	.32	7,518	4,511	.60
1993	238	119	.50	9,845	5,218	.53	1,138	364	.32	1,183	793	.67	590	106	.18	6,869	3,366	.49
1994	285	1,174	4.12	9,564	11,572	1.21	1,188	1,069	.90	1,217	1,387	1.14	151	69	.46	9,045	10,673	1.18
1995	329	184	.56	8,993	8,723	.97	1,549	867	.56	1,302	1,133	.87	132	66	.50	8,009	6,647	.83
1996	288	112	.39	11,009	11,449	1.04	1,475	1,047	.71	961	942	.98	162	130	.80	7,551	5,663	.75
1997	122	93	.76	10,372	9,542	.92	940	658	.70	2,958	2,130	.72	487	93	.19	6,873	5,223	.76
1998	516	392	.76	10,264	8,930	.87	601	319	.53	3,480	3,236	.93	0	0	0	6,954	5,980	.86
1999	476	243	.51	10,165	8,945	.88	400	276	.69	3,393	3,088	.91	59	10	.17	8,310	7,479	.90
2000	252	161	.64	10,427	9,801	.94	360	230	.64	3,757	4,170	1.11	166	17	.10	7,890	8,837	1.12
2001	173	206	1.19	10,082	12,098	1.20	284	99	.35	4,657	6,147	1.32	0	0	0	8,064	9,596	1.19
2002	103	139	1.35	9,726	10,601	1.09	1,228	995	.81	5,707	5,650	.99	209	209	1.0	6,234	5,922	.95
2003	319	354	1.11	9,444	12,844	1.36	1,442	1,182	.82	4,116	5,474	1.33	245	167	.68	7,235	8,971	1.24
Average	306	304	1.06	9,957	9,812	.99	993	645	.64	2,711	2,807	.97	186	74	.40	7,638	7,248	.94

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Scott County																		
1991	1,617	1,827	1.13	7,964	10,672	1.34	9,776	11,145	1.14	132	120	.91	963	1,117	1.16	46,285	64,336	1.39
1992	909	1,600	1.76	9,253	12,121	1.31	8,027	6,903	.86	590	749	1.27	1,676	1,592	.95	40,346	45,188	1.12
1993	604	821	1.36	11,111	12,667	1.14	4,683	2,763	.59	67	17	.26	729	532	.73	35,097	28,429	.81
1994	844	1,097	1.30	7,315	10,314	1.41	4,936	3,702	.75	77	221	2.87	707	509	.72	44,937	53,026	1.18
1995	702	835	1.19	8,269	10,832	1.31	4,723	3,731	.79	0	0	0	1,625	1,349	.83	45,987	49,666	1.08
1996	805	668	.83	11,235	13,145	1.17	3,870	2,593	.67	0	0	0	1,065	138	.13	42,231	36,741	.87
1997	814	700	.86	12,561	13,817	1.10	3,181	1,622	.51	58	72	1.24	941	640	.68	42,442	36,076	.85
1998	618	655	1.06	13,293	15,686	1.18	1,384	747	.54	345	290	.84	1,157	891	.77	43,923	33,821	.77
1999	525	1,150	2.19	15,527	17,080	1.10	1,988	1,491	.75	370	466	1.26	261	125	.48	39,321	33,030	.84
2000	435	579	1.33	17,271	23,834	1.38	920	764	.83	127	118	.93	927	473	.51	41,494	39,419	.95
2001	435	813	1.87	14,967	17,212	1.15	1,661	947	.57	113	104	.92	791	506	.64	40,483	31,982	.79
2002	475	817	1.72	12,220	19,674	1.61	2,079	2,183	1.05	214	289	1.35	733	520	.71	45,617	46,986	1.03
2003	435	796	1.83	7,353	9,927	1.35	3,467	2,704	.78	228	228	10	1,212	812	.67	46,902	46,902	10
Average	709	951	1.42	11,411	14,383	1.27	3,900	3,177	.76	179	206	.99	984	708	.69	42,697	41,969	.98
Sedgwick County																		
1991	484	455	.94	8,393	11,079	1.32	2,012	1,771	.88	9,651	12,257	1.27	171	96	.56	14,709	16,768	1.14
1992	743	438	.59	7,228	5,710	.79	4,008	2,445	.61	8,898	7,652	.86	379	53	.14	11,748	9,163	.78
1993	244	351	1.44	7,385	6,277	.85	2,154	1,465	.68	9,166	8,983	.98	255	56	.22	15,175	11,381	.75
1994	60	93	1.55	8,032	9,317	1.16	1,726	1,588	.92	10,571	11,945	1.13	321	144	.45	14,713	14,860	1.01
1995	344	275	.80	8,607	8,177	.95	2,413	1,279	.53	9,463	8,327	.88	461	212	.46	15,029	12,324	.82
1996	40	42	1.05	9,206	9,758	1.06	2,338	1,403	.60	8,707	7,836	.90	384	165	.43	16,088	13,675	.85
1997	352	158	.45	8,709	6,880	.79	1,735	920	.53	12,302	9,103	.74	96	81	.84	13,869	10,124	.73
1998	200	148	.74	8,388	8,807	1.05	1,505	1,069	.71	12,644	13,023	1.03	212	148	.70	15,164	14,406	.95
1999	149	67	.45	10,071	7,755	.77	1,355	759	.56	12,274	10,678	.87	176	134	.76	14,705	11,617	.79
2000	204	114	.56	9,945	9,050	.91	1,404	856	.61	11,431	12,460	1.09	150	98	.65	14,950	14,502	.97
2001	289	277	.96	10,658	12,363	1.16	870	800	.92	12,998	14,558	1.12	102	91	.89	13,637	14,864	1.09
2002	447	425	.95	13,248	14,175	1.07	759	554	.73	12,573	13,327	1.06	267	230	.86	13,949	13,670	.98
2003	78	9	.12	13,245	14,834	1.12	1,478	1,315	.89	10,405	11,966	1.15	224	65	.29	14,002	14,562	1.04
Average	280	220	.82	9,470	9,553	10	1,827	1,248	.71	10,853	10,932	1.01	246	121	.56	14,441	13,224	.92

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Seward County																		
1991	7,093	18,726	2.64	6,912	14,100	2.04	3,361	4,403	1.31	126	158	1.25	5,781	6,475	1.12	86,623	155,921	1.80
1992	5,532	13,664	2.47	10,268	17,969	1.75	1,426	1,440	1.01	0	0	0	5,633	6,253	1.11	86,434	134,837	1.56
1993	6,204	11,664	1.88	10,575	18,718	1.77	1,930	2,567	1.33	0	0	0	4,433	4,477	1.01	84,723	113,529	1.34
1994	5,652	10,682	1.89	14,892	25,614	1.72	881	696	.79	0	0	0	3,488	3,244	.93	84,109	125,322	1.49
1995	6,367	14,135	2.22	14,458	24,723	1.71	1,332	1,372	1.03	0	0	0	3,000	2,580	.86	83,141	125,543	1.51
1996	7,549	15,023	1.99	20,646	36,543	1.77	3,060	3,182	1.04	205	84	.41	2,298	2,873	1.25	74,969	107,206	1.43
1997	7,914	14,008	1.77	21,361	32,255	1.51	1,902	2,111	1.11	0	0	0	3,130	3,443	1.10	82,275	99,553	1.21
1998	8,519	15,079	1.77	25,519	41,596	1.63	1,649	1,468	.89	821	731	.89	1,812	1,268	.70	84,897	97,632	1.15
1999	9,027	10,923	1.21	26,159	36,884	1.41	956	908	.95	4,024	3,783	.94	1,209	822	.68	81,386	82,200	1.01
2000	7,019	10,037	1.43	27,984	45,334	1.62	890	685	.77	3,670	5,432	1.48	1,724	1,776	1.03	80,876	97,860	1.21
2001	6,936	11,167	1.61	30,964	46,756	1.51	877	754	.86	2,087	2,859	1.37	1,546	696	.45	83,930	94,841	1.13
2002	8,679	15,188	1.75	29,245	58,782	2.01	305	296	.97	1,702	2,774	1.63	2,196	1,449	.66	88,786	126,076	1.42
2003	8,843	12,469	1.41	23,603	37,293	1.58	1,049	808	.77	4,245	4,712	1.11	2,712	1,654	.61	77,339	90,487	1.17
Average	7,333	13,289	1.85	20,199	33,582	1.69	1,509	1,592	.99	1,298	1,579	.70	2,997	2,847	.89	83,038	111,616	1.34
Sheridan County																		
1991	1,466	2,067	1.41	32,022	50,595	1.58	4,483	5,335	1.19	605	962	1.59	1,455	1,019	.70	32,680	46,079	1.41
1992	938	507	.54	35,531	31,623	.89	2,559	1,356	.53	806	524	.65	1,136	761	.67	26,099	17,747	.68
1993	1,538	677	.44	40,105	25,667	.64	1,563	750	.48	1,110	544	.49	1,127	372	.33	21,695	9,546	.44
1994	1,101	683	.62	42,504	53,130	1.25	1,744	1,500	.86	301	403	1.34	500	430	.86	25,589	26,613	1.04
1995	1,460	1,241	.85	39,769	52,495	1.32	2,223	2,090	.94	608	663	1.09	1,122	449	.40	26,529	28,917	1.09
1996	1,445	1,170	.81	44,289	47,389	1.07	1,934	1,431	.74	293	384	1.31	562	337	.60	24,845	21,615	.87
1997	1,992	1,833	.92	49,432	50,915	1.03	1,739	1,165	.67	1,196	909	.76	729	416	.57	19,953	16,561	.83
1998	1,561	1,655	1.06	52,776	53,304	1.01	1,132	1,041	.92	598	574	.96	509	158	.31	18,300	14,274	.78
1999	1,872	1,498	.80	51,600	45,408	.88	821	608	.74	2,221	1,310	.59	240	31	.13	18,556	13,175	.71
2000	1,707	1,690	.99	54,723	74,423	1.36	814	773	.95	1,546	1,840	1.19	510	332	.65	17,462	18,510	1.06
2001	1,508	1,342	.89	46,946	54,927	1.17	256	143	.56	4,536	4,808	1.06	320	61	.19	20,602	19,984	.97
2002	1,477	1,684	1.14	45,600	66,120	1.45	935	1,262	1.35	3,557	4,766	1.34	125	23	.18	24,738	29,933	1.21
2003	1,854	2,225	1.20	34,977	50,017	1.43	1,749	1,732	.99	2,988	3,944	1.32	2,496	1,248	.50	33,581	38,954	1.16
Average	1,532	1,405	.90	43,867	50,463	1.16	1,689	1,476	.84	1,567	1,664	1.05	833	433	.47	23,895	23,224	.94

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Sherman County																		
1991	2,106	3,138	1.49	24,571	34,154	1.39	5,812	7,962	1.37	1,289	1,315	1.02	7,863	6,055	0.77	65,383	92,190	1.41
1992	1,184	1,409	1.19	30,821	30,513	.99	5,208	3,958	.76	1,319	712	.54	6,561	3,740	.57	58,387	39,703	.68
1993	1,700	1,530	.90	31,267	29,704	.95	116	65	.56	1,140	718	.63	8,540	4,697	.55	62,606	27,547	.44
1994	1,403	1,557	1.11	36,387	45,120	1.24	385	281	.73	473	284	.60	6,546	3,862	.59	65,262	67,872	1.04
1995	1,927	2,100	1.09	31,107	38,262	1.23	2,481	1,786	.72	365	318	.87	9,205	4,418	.48	58,666	63,946	1.09
1996	1,780	1,833	1.03	48,320	57,501	1.19	281	180	.64	219	230	1.05	6,883	3,579	.52	57,116	49,691	.87
1997	1,945	2,529	1.30	51,009	69,882	1.37	459	326	.71	1,739	1,948	1.12	6,977	3,837	.55	54,696	45,398	.83
1998	2,906	3,516	1.21	52,390	64,440	1.23	944	396	.42	2,508	2,383	.95	5,396	2,914	.54	52,467	40,924	.78
1999	3,056	3,362	1.10	53,013	57,254	1.08	879	563	.64	1,755	1,843	1.05	6,216	3,294	.53	49,096	34,858	.71
2000	2,609	3,574	1.37	55,260	77,917	1.41	417	334	.80	5,064	6,786	1.34	4,377	2,670	.61	47,869	50,741	1.06
2001	2,929	4,276	1.46	51,427	69,941	1.36	1,994	1,336	.67	4,217	5,018	1.19	6,153	3,815	.62	47,594	46,166	.97
2002	3,269	5,557	1.70	48,102	74,558	1.55	695	862	1.24	3,838	6,409	1.67	5,059	3,339	.66	54,538	65,991	1.21
2003	3,217	4,632	1.44	39,032	61,280	1.57	1,361	1,810	1.33	2,294	3,074	1.34	7,196	4,390	.61	63,503	73,663	1.16
Average	2,310	3,001	1.26	42,516	54,656	1.27	1,618	1,528	.81	2,017	2,387	1.03	6,690	3,893	.58	56,706	53,745	.94
Stafford County																		
1991	3,206	4,392	1.37	33,049	48,913	1.48	2,507	2,607	1.04	3,839	5,336	1.39	2,921	2,249	.77	32,923	45,105	1.37
1992	3,744	2,583	.69	34,166	27,674	.81	2,581	1,549	.60	2,602	2,342	.90	1,990	915	.46	32,242	27,406	.85
1993	3,136	1,505	.48	34,819	25,070	.72	1,469	617	.42	3,028	2,271	.75	2,881	778	.27	31,156	20,251	.65
1994	2,739	3,369	1.23	37,906	52,310	1.38	915	540	.59	2,938	4,554	1.55	828	265	.32	33,898	45,423	1.34
1995	2,833	2,266	.80	37,039	43,706	1.18	1,772	1,329	.75	3,311	3,940	1.19	1,913	1,071	.56	29,773	29,773	1.0
1996	3,206	2,565	.80	40,741	39,926	.98	919	414	.45	5,046	4,440	.88	1,604	481	.30	27,906	23,720	.85
1997	3,432	1,956	.57	39,373	33,073	.84	562	461	.82	9,112	7,563	.83	1,721	551	.32	25,983	18,448	.71
1998	4,631	4,677	1.01	39,702	44,466	1.12	340	214	.63	12,437	13,556	1.09	612	337	.55	24,059	26,465	1.10
1999	4,632	3,428	.74	36,279	36,642	1.01	293	267	.91	13,502	14,717	1.09	1,297	661	.51	26,253	24,415	.93
2000	3,242	3,566	1.10	36,126	41,906	1.16	647	705	1.09	13,195	16,494	1.25	755	325	.43	27,981	31,059	1.11
2001	3,361	3,395	1.01	40,576	51,532	1.27	885	903	1.02	10,114	12,845	1.27	1,570	707	.45	25,891	30,810	1.19
2002	4,645	5,620	1.21	37,703	49,014	1.30	864	1,158	1.34	15,026	19,384	1.29	1,220	695	.57	23,212	26,694	1.15
2003	5,620	6,294	1.12	35,741	49,323	1.38	2,089	2,298	1.10	13,195	17,945	1.36	1,840	1,362	.74	22,465	27,632	1.23
Average	3,725	3,509	.93	37,171	41,812	1.13	1,219	1,005	.83	8,257	9,645	1.14	1,627	800	.48	27,980	29,015	1.04

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Stanton County																		
1991	290	400	1.38	5,852	9,656	1.65	406	857	2.11	0	0	0	4,373	4,592	1.05	141,050	221,449	1.57
1992	880	1,461	1.66	4,592	6,934	1.51	2,027	1,500	.74	0	0	0	5,859	4,629	.79	137,745	206,618	1.50
1993	949	1,300	1.37	9,892	14,047	1.42	502	628	1.25	0	0	0	4,190	3,562	.85	127,801	159,751	1.25
1994	776	1,513	1.95	9,692	16,961	1.75	292	298	1.02	0	0	0	2,963	2,400	.81	126,386	176,940	1.40
1995	530	843	1.59	10,539	18,443	1.75	673	814	1.21	0	0	0	3,000	2,040	.68	119,854	160,604	1.34
1996	610	939	1.54	10,927	18,467	1.69	972	953	.98	0	0	0	2,099	1,826	.87	116,075	134,647	1.16
1997	1,450	2,349	1.62	13,558	19,252	1.42	1,601	1,537	.96	0	0	0	2,929	1,465	.50	115,564	121,342	1.05
1998	2,552	2,731	1.07	16,283	21,656	1.33	898	853	.95	0	0	0	1,575	677	.43	113,556	114,692	1.01
1999	2,250	2,048	.91	14,390	20,434	1.42	570	507	.89	0	0	0	1,248	786	.63	117,456	126,852	1.08
2000	3,370	3,471	1.03	18,424	30,031	1.63	120	31	.26	0	0	0	1,370	877	.64	109,224	133,253	1.22
2001	3,450	4,520	1.31	19,493	24,756	1.27	795	795	1.0	0	0	0	2,329	2,073	.89	101,293	93,190	.92
2002	2,751	5,034	1.83	19,598	28,613	1.46	632	910	1.44	0	0	0	1,758	1,301	.74	117,076	125,271	1.07
2003	3,620	5,285	1.46	11,186	17,115	1.53	632	430	.68	360	360	1.0	3,937	2,402	.61	96,928	112,436	1.16
Average	1,806	2,453	1.44	12,648	18,951	1.53	778	778	1.04	28	28	.08	2,895	2,202	.73	118,462	145,157	1.21
Stevens County																		
1991	6,340	13,251	2.09	15,216	29,215	1.92	2,715	4,507	1.66	0	0	0	3,699	4,809	1.30	109,545	184,036	1.68
1992	5,011	10,423	2.08	16,789	30,724	1.83	1,841	2,154	1.17	255	204	.80	2,234	2,882	1.29	114,234	179,347	1.57
1993	4,875	7,410	1.52	19,752	29,035	1.47	245	255	1.04	0	0	0	2,026	1,722	.85	109,452	142,288	1.30
1994	5,448	10,515	1.93	22,001	36,522	1.66	60	16	.27	0	0	0	1,742	1,516	.87	108,376	158,229	1.46
1995	4,740	10,949	2.31	22,676	37,415	1.65	872	1,247	1.43	0	0	0	2,698	2,455	.91	109,020	156,989	1.44
1996	4,664	9,981	2.14	25,744	47,112	1.83	1,015	1,654	1.63	485	858	1.77	1,221	965	.79	108,242	151,539	1.40
1997	5,875	10,751	1.83	35,609	53,414	1.50	462	587	1.27	215	217	1.01	1,261	870	.69	113,120	141,400	1.25
1998	4,798	9,164	1.91	43,645	65,031	1.49	80	78	.98	395	419	1.06	1,207	338	.28	111,014	142,098	1.28
1999	2,778	4,111	1.48	49,687	71,052	1.43	1,353	501	.37	890	1,121	1.26	2,207	1,081	.49	112,169	120,021	1.07
2000	2,201	3,390	1.54	62,127	100,646	1.62	0	0	0	252	277	1.10	2,276	2,071	.91	105,051	130,263	1.24
2001	2,412	3,883	1.61	58,009	84,693	1.46	475	290	.61	906	788	.87	3,033	1,547	.51	103,840	119,416	1.15
2002	2,843	4,862	1.71	50,906	101,303	1.99	860	697	.81	1,359	2,732	2.01	2,611	2,924	1.12	113,490	170,235	1.50
2003	3,928	5,264	1.34	49,490	70,771	1.43	2,183	939	.43	120	162	1.35	3,235	2,750	.85	112,093	123,302	1.10
Average	4,301	7,996	1.81	36,281	58,226	1.64	935	994	.90	375	521	.86	2,265	1,995	.84	109,973	147,628	1.34

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Thomas County																		
1991	533	965	1.81	54,600	82,992	1.52	5,373	6,394	1.19	2,542	2,872	1.13	3,217	1,512	0.47	31,362	37,321	1.19
1992	901	649	.72	44,989	32,842	.73	11,795	7,785	.66	3,345	2,174	.65	3,417	1,674	.49	28,353	17,862	.63
1993	561	847	1.51	57,875	49,773	.86	2,178	1,024	.47	948	502	.53	2,198	835	.38	31,403	18,528	.59
1994	826	1,330	1.61	60,345	73,621	1.22	2,021	1,597	.79	2,108	2,045	.97	1,422	569	.40	32,015	28,173	.88
1995	734	749	1.02	56,035	67,242	1.20	1,605	1,316	.82	1,651	1,833	1.11	3,304	958	.29	31,998	26,878	.84
1996	815	791	.97	67,052	72,416	1.08	1,427	1,127	.79	1,701	1,412	.83	1,987	934	.47	25,871	21,732	.84
1997	900	1,233	1.37	72,028	83,552	1.16	1,146	1,020	.89	2,354	2,613	1.11	2,229	1,271	.57	21,318	20,252	.95
1998	1,213	1,589	1.31	65,349	71,230	1.09	1,008	615	.61	4,004	3,604	.90	1,835	1,119	.61	25,186	20,653	.82
1999	747	769	1.03	63,680	57,949	.91	420	265	.63	4,080	2,897	.71	2,175	1,088	.50	28,088	19,662	.70
2000	722	989	1.37	63,197	89,740	1.42	242	174	.72	5,303	6,311	1.19	1,939	989	.51	30,291	35,743	1.18
2001	1,161	1,416	1.22	54,418	68,023	1.25	1,463	775	.53	6,318	6,823	1.08	3,369	1,516	.45	33,135	31,478	.95
2002	1,508	2,533	1.68	52,141	76,126	1.46	1,032	815	.79	6,084	8,153	1.34	1,793	1,488	.83	38,968	46,372	1.19
2003	1,673	2,443	1.46	38,859	54,014	1.39	2,647	2,118	.80	6,458	7,039	1.09	5,595	3,917	.70	46,320	51,878	1.12
Average	946	1,254	1.31	57,736	67,655	1.18	2,489	1,925	.75	3,607	3,714	.97	2,652	1,375	.51	31,101	28,964	.91
Wallace County																		
1991	1,248	2,309	1.85	16,422	25,454	1.55	1,481	1,377	.93	40	113	2.82	3,454	1,692	.49	37,716	56,197	1.49
1992	1,271	2,072	1.63	19,840	26,387	1.33	1,771	1,913	1.08	120	126	1.05	3,000	1,650	.55	30,741	35,660	1.16
1993	1,347	1,576	1.17	20,016	21,617	1.08	1,045	700	.67	0	0	0	2,430	729	.30	33,437	29,759	.89
1994	1,889	2,588	1.37	20,420	31,038	1.52	669	622	.93	0	0	0	1,691	609	.36	34,339	40,520	1.18
1995	1,473	2,121	1.44	18,761	26,265	1.40	856	805	.94	0	0	0	3,698	2,145	.58	32,445	37,636	1.16
1996	1,803	3,137	1.74	24,211	35,590	1.47	341	280	.82	0	0	0	2,727	1,445	.53	32,513	39,991	1.23
1997	1,481	2,310	1.56	25,094	31,117	1.24	430	232	.54	0	0	0	5,621	3,035	.54	27,947	27,668	.99
1998	1,018	1,619	1.59	24,538	31,899	1.30	640	282	.44	245	196	.80	4,416	3,047	.69	29,716	29,419	.99
1999	913	1,187	1.30	23,337	27,071	1.16	346	197	.57	495	396	.80	2,359	1,203	.51	33,210	29,557	.89
2000	1,007	1,541	1.53	24,094	37,828	1.57	369	284	.77	130	215	1.65	2,131	1,641	.77	33,101	40,052	1.21
2001	1,314	2,707	2.06	19,374	27,705	1.43	665	479	.72	250	363	1.45	2,437	1,365	.56	35,958	37,396	1.04
2002	1,211	1,720	1.42	19,482	32,535	1.67	253	235	.93	365	299	.82	2,596	1,713	.66	35,320	48,388	1.37
2003	1,409	1,930	1.37	13,876	19,426	1.40	257	129	.50	247	319	1.29	4,572	2,789	.61	36,522	40,539	1.11
Average	1,337	2,063	1.54	20,728	28,764	1.39	702	580	.76	146	156	.82	3,164	1,774	.55	33,305	37,906	1.13

Table 2. Irrigation water use, acres irrigated, and irrigation application rate by crop type for counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-foot; acre-ft/acre, acre-foot per acre]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
Wichita County																		
1991	403	669	1.66	3,936	6,691	1.70	3,915	4,933	1.26	261	318	1.22	2,383	1,978	0.83	79,313	104,693	1.32
1992	420	735	1.75	2,660	2,899	1.09	2,568	2,208	.86	206	130	.63	1,896	1,536	.81	76,929	82,314	1.07
1993	396	372	.94	9,792	10,380	1.06	4,102	3,733	.91	0	0	0	2,197	945	.43	57,668	46,711	.81
1994	570	781	1.37	4,993	7,340	1.47	4,106	3,819	.93	120	60	.50	1,489	983	.66	68,753	77,003	1.12
1995	342	595	1.74	7,911	10,601	1.34	3,800	3,382	.89	0	0	0	1,744	1,325	.76	66,962	65,623	.98
1996	674	674	1.0	10,975	12,951	1.18	4,211	3,706	.88	118	81	.69	738	391	.53	63,061	60,539	.96
1997	861	1,076	1.25	11,011	11,782	1.07	3,376	2,296	.68	366	264	.72	1,914	1,225	.64	64,660	54,961	.85
1998	947	1,127	1.19	11,121	13,012	1.17	1,015	619	.61	282	133	.47	824	577	.70	63,307	52,545	.83
1999	712	790	1.11	11,617	13,824	1.19	403	520	1.29	515	633	1.23	2,410	1,277	.53	66,561	53,249	.80
2000	666	852	1.28	10,155	14,826	1.46	773	665	.86	541	487	.90	2,683	1,583	.59	68,529	67,844	.99
2001	434	573	1.32	10,307	10,513	1.02	1,420	966	.68	357	332	.93	1,419	568	.40	61,413	49,130	.80
2002	327	592	1.81	7,682	11,600	1.51	1,371	1,549	1.13	471	542	1.15	1,182	898	.76	70,464	71,169	1.01
2003	347	507	1.46	5,321	6,811	1.28	1,509	936	.62	106	123	1.16	3,386	1,727	.51	65,012	53,960	.83
Average	546	719	1.38	8,268	10,248	1.27	2,505	2,256	.89	257	239	.74	1,867	1,155	.63	67,126	64,595	.95

Table 3. Irrigation water use, acres irrigated, and irrigation application rate by system type for the Groundwater Management Districts within the Kansas High Plains, 1991–2003.

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft/acre, acre-foot per acre]

Ground-water Management District (GMD) number (fig. 1)	Total irrigation water use		Total acres irrigated		Average rate of irrigation (acre-ft/yr)	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
	Acre-feet	Percentage of total for all GMDs	Acres	Percentage of total for all GMDs		Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991																	
1	355,589	8.4	262,528	9.6	1.35	216,196	299,120	1.38	34,172	39,671	1.16	0	0	0	12,160	16,798	1.38
2	112,604	2.7	97,833	3.6	1.15	37,604	47,438	1.26	52,475	57,681	1.10	0	0	0	7,754	7,485	.97
3	2,660,233	63.1	1,593,191	58.0	1.67	823,757	1,417,562	1.72	604,248	974,993	1.61	0	0	0	165,186	267,678	1.62
4	478,854	11.4	360,109	13.1	1.33	111,066	173,659	1.56	218,417	263,077	1.20	0	0	0	30,626	42,118	1.38
5	606,672	14.4	434,745	15.8	1.40	66,906	98,928	1.48	358,046	494,995	1.38	0	0	0	9,793	12,749	1.30
Totals	4,213,952	100	2,748,406	100	1.53	1,255,529	2,036,707	1.62	1,267,358	1,830,417	1.44	0	0	0	225,519	346,828	1.54
1992																	
1	270,143	8.7	244,582	9.1	1.10	188,730	216,103	1.15	30,403	30,008	.99	12,209	13,003	1.07	13,240	11,029	.83
2	57,195	1.8	92,880	3.5	.62	33,125	22,523	.68	52,029	30,556	.59	1,608	619	.38	6,118	3,497	.57
3	2,178,273	70.2	1,580,084	59.0	1.38	783,385	1,120,560	1.43	574,112	773,720	1.35	52,305	62,683	1.20	170,282	221,310	1.30
4	268,217	8.6	340,522	12.7	.79	83,917	82,776	.99	186,421	133,135	.71	43,379	31,187	.72	26,805	21,119	.79
5	330,406	10.6	418,749	15.6	.79	53,548	34,700	.65	342,227	278,906	.81	15,919	11,997	.75	7,055	4,803	.68
Totals	3,104,234	100	2,676,817	100	1.16	1,142,705	1,476,662	1.29	1,185,192	1,246,325	1.05	125,420	119,489	.95	223,500	261,758	1.17
1993																	
1	197,600	7.3	223,046	8.5	.89	153,685	141,603	.92	30,312	24,862	.82	21,564	17,978	.83	17,485	13,157	.75
2	59,150	2.2	90,525	3.5	.65	31,261	22,283	.71	52,474	33,068	.63	1,048	711	.68	5,742	3,088	.54
3	1,887,823	69.6	1,550,396	59.2	1.22	688,521	859,444	1.25	601,448	740,184	1.23	56,285	62,973	1.12	204,142	225,222	1.10
4	261,648	9.6	343,660	13.1	.76	77,960	79,034	1.01	180,509	127,103	.70	60,882	38,516	.63	24,309	16,995	.70
5	308,474	11.4	410,330	15.7	.75	48,087	27,207	.57	346,260	268,263	.77	8,495	8,095	.95	7,488	4,909	.66
Totals	2,714,695	100	2,617,957	100	1.04	999,514	1,129,571	1.13	1,211,003	1,193,480	.99	148,274	128,273	.87	259,166	263,371	1.02
1994																	
1	281,921	7.9	236,993	8.8	1.19	152,462	183,734	1.21	35,593	41,356	1.16	24,495	26,488	1.08	24,443	30,343	1.24
2	100,583	2.8	97,243	3.6	1.03	33,648	38,253	1.14	53,525	52,899	.99	1,108	872	.79	8,962	8,559	.96
3	2,239,152	62.5	1,555,565	58.0	1.44	602,004	903,099	1.50	609,548	868,895	1.43	88,960	124,034	1.39	255,053	343,124	1.35
4	396,603	11.1	367,070	13.7	1.08	74,031	97,211	1.31	184,188	191,807	1.04	73,774	73,634	1.00	35,077	33,951	.97
5	565,785	15.8	428,022	15.9	1.32	56,293	73,273	1.30	352,781	469,318	1.33	9,305	12,269	1.32	9,643	10,925	1.13
Totals	3,584,044	100	2,684,893	100	1.33	918,438	1,295,570	1.41	1,235,635	1,624,275	1.31	197,642	237,297	1.20	333,178	426,902	1.28
1995																	
1	258,857	7.9	242,512	9.1	1.07	136,550	155,854	1.14	41,565	40,900	.98	33,328	32,913	.99	31,069	29,190	.94
2	84,940	2.6	97,814	3.7	.87	31,246	29,015	.93	56,895	48,279	.85	1,669	1,094	.66	8,004	6,552	.82
3	2,109,913	64.5	1,533,409	57.8	1.38	486,039	708,401	1.46	657,248	882,965	1.34	93,271	125,052	1.34	296,851	393,495	1.33
4	361,778	11.1	355,259	13.4	1.02	60,157	73,850	1.23	195,033	193,008	.99	74,158	69,698	.94	25,911	25,222	.97
5	453,515	13.9	426,810	16.1	1.06	57,069	56,766	.99	348,025	375,065	1.08	14,367	14,473	1.01	7,349	7,211	.98
Totals	3,269,003	100	2,655,804	100	1.23	771,061	1,023,886	1.33	1,298,766	1,540,217	1.19	216,793	243,230	1.12	369,184	461,670	1.25

Table 3. Irrigation water use, acres irrigated, and irrigation application rate by system type for the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft/acre, acre-foot per acre]

Groundwater Management District (GMD) number (fig. 1)	Total irrigation water use		Total acres irrigated		Average rate of irrigation (acre-ft/yr)	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
	Acre-feet	Percentage of total for all GMDs	Acres	Percentage of total for all GMDs		Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1996																	
1	250,042	8.3	242,642	9.1	1.03	123,648	131,803	1.07	48,318	46,961	0.97	42,166	41,796	0.99	28,510	29,482	1.03
2	86,645	2.9	103,597	3.9	.84	29,702	28,537	.96	63,406	50,110	.79	2,289	1,924	.84	8,200	6,074	.74
3	1,949,992	64.5	1,524,257	57.0	1.28	442,764	597,295	1.35	684,371	857,864	1.25	113,215	141,655	1.25	283,907	353,178	1.24
4	364,688	12.1	370,641	13.9	.98	52,973	62,599	1.18	199,944	192,755	.96	85,604	78,055	.91	32,120	31,279	.97
5	371,749	12.3	431,379	16.1	.86	49,876	41,465	.83	355,894	309,488	.87	18,249	15,647	.86	7,360	5,149	.70
Totals	3,023,116	100	2,672,516	100	1.13	698,963	861,699	1.23	1,351,933	1,457,178	1.08	261,523	279,077	1.07	360,097	425,162	1.18
1997																	
1	225,872	7.8	246,497	9.0	.92	106,858	105,247	.98	41,150	33,529	.81	69,341	60,145	.87	29,148	26,951	.92
2	76,457	2.6	106,771	3.9	.72	27,709	22,793	.82	42,920	29,687	.69	28,158	18,578	.66	7,984	5,399	.68
3	1,851,794	63.7	1,576,430	57.3	1.17	355,973	431,904	1.21	516,487	623,105	1.21	393,274	465,788	1.18	310,696	330,997	1.07
4	413,066	14.2	381,935	13.9	1.08	44,908	54,950	1.22	136,971	142,795	1.04	170,738	184,679	1.08	29,318	30,642	1.05
5	341,855	11.8	439,038	16.0	.78	46,642	34,089	.73	269,480	211,070	.78	115,490	91,938	.80	7,426	4,758	.64
Totals	2,909,044	100	2,750,671	100	1.06	582,090	648,983	1.11	1,007,008	1,040,186	1.03	777,001	821,128	1.06	384,572	398,747	1.04
1998																	
1	223,389	7.1	244,883	8.8	.91	86,245	81,677	.95	44,591	37,746	.85	79,805	75,122	.94	34,242	28,844	.84
2	100,825	3.2	110,441	4.0	.91	26,502	27,643	1.04	39,608	32,975	.83	32,294	29,975	.93	12,037	10,232	.85
3	1,940,161	61.6	1,583,403	57.2	1.23	280,187	326,765	1.17	481,008	619,532	1.29	474,580	599,184	1.26	347,628	394,680	1.14
4	376,852	12.0	380,712	13.8	.99	32,801	36,220	1.10	104,022	101,738	.98	212,541	209,301	.98	31,348	29,593	.94
5	511,214	16.2	448,803	16.2	1.14	43,939	41,606	.95	219,963	254,895	1.16	167,639	194,692	1.16	17,262	20,021	1.16
Totals	3,152,441	100	2,768,242	100	1.14	469,674	513,911	1.09	889,192	1,046,886	1.18	966,859	1,108,274	1.15	442,517	483,370	1.09
1999																	
1	219,915	7.7	246,636	8.8	.89	77,205	75,953	.98	40,196	33,389	.83	93,569	79,546	.85	35,666	31,027	.87
2	85,121	3.0	114,635	4.1	.74	26,588	22,574	.85	35,230	24,622	.70	42,404	30,645	.72	10,413	7,280	.70
3	1,759,432	61.5	1,594,865	57.1	1.10	239,048	259,471	1.09	409,610	468,742	1.14	586,912	663,830	1.13	359,295	367,389	1.02
4	331,370	11.6	378,827	13.6	.87	26,988	28,555	1.06	95,372	80,905	.85	219,918	189,915	.86	36,549	31,995	.88
5	463,473	16.2	457,878	16.4	1.01	42,592	35,707	.84	209,721	217,124	1.04	189,085	195,702	1.03	16,480	14,940	.91
Totals	2,859,311	100	2,792,841	100	1.02	412,421	422,260	1.02	790,129	824,782	1.04	1,131,888	1,159,638	1.02	458,403	452,631	.99
2000																	
1	275,750	7.9	250,274	9.0	1.10	66,913	75,083	1.12	27,605	27,129	.98	119,262	131,780	1.10	36,494	41,758	1.14
2	112,448	3.2	116,186	4.2	.97	26,875	30,136	1.12	25,159	21,843	.87	52,818	50,443	.96	11,334	10,026	.88
3	2,117,282	60.4	1,584,541	56.9	1.34	207,349	265,080	1.28	327,109	444,594	1.36	716,366	995,219	1.39	333,717	412,389	1.24
4	472,688	13.5	374,945	13.5	1.26	20,792	30,969	1.49	70,750	86,909	1.23	250,894	316,092	1.26	32,509	38,718	1.19
5	528,801	15.1	458,336	16.5	1.15	38,213	41,422	1.08	174,385	204,296	1.17	229,741	265,459	1.16	15,997	17,624	1.10
Totals	3,506,969	100	2,784,282	100	1.26	360,142	442,690	1.23	625,008	784,771	1.26	1,369,081	1,758,993	1.28	430,051	520,515	1.21

Table 3. Irrigation water use, acres irrigated, and irrigation application rate by system type for the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft/acre, acre-foot per acre]

Ground-water Management District (GMD) number (fig. 1)	Total irrigation water use		Total acres irrigated		Average rate of irrigation (acre-ft/yr)	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Other irrigation systems		
	Acre-feet	Percentage of total for all GMDs	Acres	Percentage of total for all GMDs		Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
2001																	
1	226,216	7.0	237,016	8.7	0.95	52,491	53,405	1.02	29,663	26,016	0.88	120,284	115,239	0.96	34,578	31,556	0.91
2	131,639	4.1	117,476	4.3	1.12	25,419	31,743	1.25	25,522	26,152	1.02	54,087	60,227	1.11	12,448	13,517	1.09
3	1,889,226	58.7	1,552,436	56.7	1.22	163,657	187,146	1.14	277,253	338,657	1.22	771,727	974,471	1.26	339,799	388,952	1.14
4	402,236	12.5	367,627	13.4	1.09	16,830	20,649	1.23	57,955	64,016	1.10	260,665	281,731	1.08	32,177	35,840	1.11
5	567,745	17.6	462,003	16.9	1.23	39,014	41,734	1.07	143,220	176,108	1.23	258,986	325,155	1.26	20,783	24,748	1.19
Totals	3,217,062	100	2,736,558	100	1.18	297,411	334,677	1.13	533,613	630,949	1.18	1,465,749	1,756,823	1.20	439,785	494,613	1.12
2002																	
1	286,707	7.5	243,617	8.7	1.18	51,732	61,436	1.19	23,716	26,216	1.11	123,104	147,330	1.20	45,065	51,725	1.15
2	125,933	3.3	120,840	4.3	1.04	24,826	30,690	1.24	20,090	20,116	1.00	61,401	61,132	1.00	14,523	13,995	.96
3	2,357,519	61.4	1,594,975	57.0	1.48	150,509	234,006	1.55	238,835	347,155	1.45	818,106	1,238,698	1.51	387,525	537,660	1.39
4	500,716	13.0	374,371	13.4	1.34	14,672	22,270	1.52	50,587	66,332	1.31	275,019	368,947	1.34	34,093	43,167	1.27
5	571,254	14.9	464,945	16.6	1.23	35,692	39,650	1.11	118,264	145,967	1.23	290,459	360,588	1.24	20,530	25,049	1.22
Totals	3,842,129	100	2,798,748	100	1.37	277,431	388,052	1.40	451,492	605,786	1.34	1,568,089	2,176,695	1.39	501,736	671,596	1.34
2003																	
1	236,793	7.1	235,050	8.7	1.01	47,292	49,659	1.05	18,770	17,394	.93	132,831	132,349	1.00	36,157	37,391	1.03
2	138,811	4.1	121,404	4.5	1.14	22,520	29,566	1.31	19,362	21,060	1.09	63,854	70,842	1.11	15,668	17,343	1.11
3	1,937,199	57.8	1,514,599	56.0	1.28	112,449	144,707	1.29	215,483	266,573	1.24	842,524	1,094,106	1.30	344,143	431,813	1.25
4	460,830	13.8	375,994	13.9	1.23	11,610	16,227	1.40	49,425	57,226	1.16	283,226	349,235	1.23	31,733	38,142	1.20
5	575,807	17.2	456,932	16.9	1.26	30,817	39,546	1.28	99,141	126,458	1.28	307,325	385,951	1.26	19,649	23,852	1.21
Totals	3,349,440	100	2,703,979	100	1.24	224,688	279,705	1.24	402,181	488,711	1.22	1,629,760	2,032,483	1.25	447,350	548,541	1.23

Table 4. Irrigation water use, acres irrigated, and irrigation application rate by crop type for the Groundwater Management Districts within the Kansas High Plains, 1991–2003.

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft/acre, acre-foot per acre]

Ground-water Management District number (fig. 1)	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple Use		
	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)
1991																		
1	3,061	4,431	1.45	41,584	64,116	1.54	15,576	18,257	1.17	301	431	1.43	7,655	5,800	0.76	194,351	262,554	1.35
2	1,311	1,173	.90	22,721	29,650	1.30	7,304	5,589	.77	13,733	15,487	1.13	721	418	.58	52,043	60,286	1.16
3	112,077	227,401	2.03	186,557	356,541	1.91	49,141	72,187	1.47	9,440	14,308	1.52	82,560	90,641	1.10	1,153,416	1,899,155	1.65
4	6,383	9,317	1.46	140,359	212,020	1.51	23,474	28,699	1.22	5,604	6,630	1.18	15,816	11,209	.71	168,473	210,980	1.25
5	47,721	68,609	1.44	158,182	232,206	1.47	18,691	21,402	1.15	29,079	40,321	1.39	15,114	10,958	.73	165,958	233,176	1.41
Totals	170,553	310,931	1.82	549,403	894,533	1.63	114,186	146,134	1.28	58,157	77,177	1.33	121,866	119,026	.98	1,734,241	2,666,151	1.54
1992																		
1	2,828	4,524	1.60	48,455	62,838	1.30	12,940	11,602	.90	916	1,003	1.10	7,974	5,652	.71	171,469	184,524	1.08
2	1,730	1,077	.62	19,827	11,723	.59	8,719	4,837	.55	13,589	9,599	.71	927	329	.36	48,088	29,629	.62
3	104,396	175,814	1.68	217,375	336,529	1.55	42,784	39,958	.93	10,676	10,342	.97	79,339	81,315	1.02	1,125,514	1,534,314	1.36
4	5,237	4,765	.91	139,908	119,470	.85	28,445	20,129	.71	6,996	4,705	.67	15,184	8,169	.54	144,752	110,979	.77
5	42,745	37,283	.87	180,103	152,136	.84	18,262	9,483	.52	21,307	16,609	.78	14,586	7,734	.53	141,746	107,162	.76
Totals	156,936	223,463	1.42	605,668	682,696	1.13	111,150	86,009	.77	53,484	42,258	.79	118,010	103,199	.87	1,631,569	1,966,608	1.21
1993																		
1	2,034	2,608	1.28	58,762	64,761	1.10	9,997	7,270	.73	67	17	.26	5,459	2,409	.44	146,727	120,534	.82
2	1,000	507	.51	20,270	14,016	.69	4,813	2,213	.46	12,330	9,371	.76	633	114	.18	51,479	32,928	.64
3	103,698	162,041	1.56	259,940	390,866	1.50	26,218	21,496	.82	6,799	6,715	.99	68,829	55,768	.81	1,084,912	1,250,936	1.15
4	6,289	4,808	.76	164,651	139,859	.85	6,759	3,405	.50	4,489	2,536	.57	16,204	7,811	.48	145,268	103,228	.71
5	40,900	28,089	.69	184,608	158,642	.86	12,528	5,227	.42	23,824	18,912	.79	11,746	3,497	.30	136,724	94,107	.69
All	153,921	198,053	1.29	688,231	768,144	1.12	60,315	39,611	.66	47,509	37,551	.79	102,871	69,599	.68	1,565,110	1,601,733	1.02
1994																		
1	3,015	3,990	1.32	50,703	73,305	1.45	10,029	8,526	.85	317	403	1.27	4,566	2,477	.54	168,363	193,220	1.15
2	1,179	1,382	1.17	21,342	24,224	1.14	4,076	3,498	.86	16,155	17,032	1.05	802	213	.27	53,689	54,234	1.01
3	109,133	199,017	1.82	277,076	464,174	1.68	20,143	20,990	1.04	6,735	9,086	1.35	59,655	56,857	.95	1,082,823	1,489,030	1.38
4	5,676	5,800	1.02	177,265	218,340	1.23	7,125	5,941	.83	3,929	3,709	.94	11,625	6,803	.59	161,450	156,009	.97
5	41,386	56,319	1.36	189,124	264,327	1.40	11,889	11,158	.94	29,119	38,466	1.32	7,308	5,613	.77	149,196	189,901	1.27
Totals	160,389	266,508	1.66	715,510	1,044,370	1.46	53,262	50,113	.94	56,255	68,696	1.22	83,956	71,963	.86	1,615,521	2,082,394	1.29
1995																		
1	1,944	2,992	1.54	54,699	68,045	1.24	9,488	8,107	.85	0	0	.00	7,371	5,126	.70	169,010	174,586	1.03
2	1,178	717	.61	20,084	19,902	.99	7,060	4,822	.68	15,803	14,032	.89	1,227	393	.32	52,462	45,075	.86
3	114,411	193,784	1.69	278,912	450,640	1.62	20,033	19,878	.99	4,709	6,199	1.32	49,554	39,819	.80	1,065,790	1,399,593	1.31
4	7,402	7,129	.96	158,766	195,690	1.23	8,364	7,067	.84	3,576	3,495	.98	17,480	8,001	.46	159,671	140,396	.88
5	40,244	37,877	.94	185,095	221,508	1.20	14,059	10,447	.74	28,128	31,444	1.12	10,071	4,496	.45	149,213	147,743	.99
Totals	165,179	242,499	1.47	697,556	955,785	1.37	59,004	50,321	.85	52,216	55,170	1.06	85,703	57,835	.67	1,596,146	1,907,393	1.19

Table 4. Irrigation water use, acres irrigated, and irrigation application rate by crop type for the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft/acre, acre-foot per acre]

Ground-water Management District number (fig. 1)	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple Use		
	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)
1996																		
1	2,902	3,458	1.19	66,332	82,493	1.24	9,267	6,801	0.73	118	82	0.69	4,597	2,082	0.45	159,426	155,127	0.97
2	1,195	847	.71	24,474	24,680	1.01	5,578	3,615	.65	15,063	11,988	.80	1,490	489	.33	55,797	45,027	.81
3	108,819	168,783	1.55	331,052	489,911	1.48	20,459	16,720	.82	4,855	4,083	.84	36,924	30,617	.83	1,022,148	1,239,878	1.21
4	7,200	6,499	.90	204,159	224,076	1.10	6,333	4,133	.65	2,504	2,264	.90	13,580	7,217	.53	136,865	120,498	.88
5	37,692	29,566	.78	210,359	200,650	.95	14,229	8,771	.62	31,627	25,044	.79	5,985	2,522	.42	131,487	105,197	.80
Totals	157,808	209,153	1.33	836,376	1,021,810	1.22	55,866	40,040	.72	54,167	43,461	.80	62,576	42,927	.69	1,505,723	1,665,727	1.11
1997																		
1	2,967	3,472	1.17	69,309	76,172	1.10	7,183	4,226	.59	544	416	.76	9,338	5,386	.58	157,156	136,200	.87
2	1,376	887	.64	26,924	21,082	.78	3,876	2,174	.56	21,919	15,898	.73	1,401	424	.30	51,275	35,993	.70
3	124,470	202,750	1.63	381,109	506,695	1.33	19,094	15,927	.83	6,724	7,227	1.07	38,921	29,771	.76	1,006,112	1,089,424	1.08
4	8,309	9,095	1.09	222,164	265,040	1.19	5,745	4,360	.76	6,348	6,523	1.03	13,982	8,530	.61	125,387	119,518	.95
5	37,009	27,488	.74	200,050	170,569	.85	10,588	6,042	.57	54,749	42,507	.78	6,481	2,322	.36	130,161	92,926	.71
Totals	174,131	243,692	1.40	899,556	1,039,558	1.16	46,486	32,729	.70	90,284	72,571	.80	70,123	46,433	.66	1,470,091	1,474,061	1.00
1998																		
1	2,859	3,486	1.22	69,902	79,262	1.13	2,960	1,659	.56	1,362	1,027	.75	6,647	4,429	.67	161,153	133,526	.83
2	1,656	1,527	.92	27,370	25,714	.94	3,698	2,576	.70	24,134	23,689	.98	1,012	476	.47	52,571	46,844	.89
3	136,561	233,416	1.71	410,369	602,187	1.47	9,130	6,924	.76	12,184	15,819	1.30	33,583	25,253	.75	981,576	1,056,562	1.08
4	9,299	10,419	1.12	219,731	240,991	1.10	4,483	2,998	.67	10,096	8,950	.89	9,518	5,203	.55	127,585	108,291	.85
5	36,064	41,255	1.14	203,016	245,091	1.21	7,602	5,766	.76	66,447	78,408	1.18	5,238	1,969	.38	130,436	138,726	1.06
Totals	186,439	290,103	1.56	930,388	1,193,245	1.28	27,873	19,923	.71	114,223	127,893	1.12	55,998	37,330	.67	1,453,321	1,483,949	1.02
1999																		
1	2,555	3,430	1.34	68,483	74,841	1.09	3,181	2,672	.84	1,462	1,612	1.10	5,492	2,454	.45	165,463	134,906	.82
2	1,248	883	.71	30,616	22,628	.74	2,993	1,768	.59	29,126	22,773	.78	684	239	.35	49,968	36,830	.74
3	130,184	185,079	1.42	422,801	565,797	1.34	11,114	8,320	.75	21,090	21,963	1.04	37,965	23,033	.61	971,711	955,240	.98
4	9,552	8,836	.93	215,832	209,552	.97	3,479	2,196	.63	12,014	9,166	.76	11,810	6,000	.51	126,140	95,620	.76
5	36,481	32,904	.90	197,704	213,070	1.08	6,840	5,358	.78	72,459	80,734	1.11	9,279	4,386	.47	135,115	127,021	.94
Totals	180,020	231,132	1.28	935,436	1,085,888	1.16	27,607	20,314	.74	136,151	136,248	1.00	65,230	36,112	.55	1,448,397	1,349,617	.93
2000																		
1	2,266	3,117	1.38	68,448	94,918	1.39	2,494	2,221	.89	1,600	1,499	.94	6,651	4,168	.63	168,815	169,827	1.01
2	918	934	1.02	28,112	25,284	.90	2,816	1,929	.69	33,760	36,285	1.07	729	250	.34	49,851	47,766	.96
3	122,033	222,914	1.83	454,130	720,060	1.59	9,357	8,154	.87	25,365	36,181	1.43	37,045	28,325	.76	936,611	1,101,647	1.18
4	7,897	9,928	1.26	215,444	298,766	1.39	2,526	2,126	.84	15,063	18,755	1.25	9,165	5,391	.59	124,850	137,721	1.10
5	30,025	34,944	1.16	207,135	243,038	1.17	6,149	5,302	.86	73,072	91,160	1.25	7,934	4,503	.57	134,021	149,854	1.12
Totals	163,139	271,837	1.67	973,269	1,382,066	1.42	23,342	19,732	.85	148,860	183,880	1.24	61,524	42,637	.69	1,414,148	1,606,815	1.14

Table 4. Irrigation water use, acres irrigated, and irrigation application rate by crop type for the Groundwater Management Districts within the Kansas High Plains, 1991–2003.—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft/acre, acre-foot per acre]

Ground-water Management District number (fig. 1)	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat			Other/Multiple Use		
	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-feet)	Rate of irrigation (acre-ft/acre)
2001																		
1	2,380	4,181	1.76	54,499	66,954	1.23	5,128	3,636	0.71	1,189	1,203	1.01	5,351	2,524	0.47	168,469	147,718	0.88
2	1,365	1,089	.80	30,904	34,676	1.12	3,134	2,722	.87	31,783	36,951	1.16	1,194	663	.55	49,096	55,537	1.13
3	144,614	240,336	1.66	407,355	584,300	1.43	11,656	9,978	.86	30,733	43,979	1.43	53,006	36,850	.70	905,072	973,783	1.08
4	8,702	11,094	1.27	185,803	233,083	1.25	6,159	5,871	.95	19,852	21,553	1.09	12,662	6,726	.53	134,449	123,908	.92
5	32,947	39,317	1.19	201,073	259,856	1.29	7,112	6,394	.90	67,948	90,203	1.33	9,696	6,164	.64	143,227	165,810	1.16
Totals	190,008	296,017	1.56	879,634	1,178,869	1.34	33,189	28,601	.86	151,505	193,889	1.28	81,909	52,927	.65	1,400,313	1,466,756	1.05
2002																		
1	2,521	3,996	1.58	47,875	75,844	1.58	4,553	5,068	1.11	1,520	1,550	1.02	5,613	4,289	.76	181,535	195,960	1.08
2	1,495	1,321	.88	35,974	38,735	1.08	3,356	2,523	.75	29,202	31,773	1.09	635	408	.64	50,178	51,173	1.02
3	159,240	298,900	1.88	382,199	673,482	1.76	18,561	18,252	.98	26,349	42,690	1.62	40,498	33,603	.83	968,128	1,290,592	1.33
4	8,801	13,601	1.55	178,199	262,899	1.48	4,393	4,553	1.04	18,856	26,376	1.40	8,869	6,056	.68	155,253	187,230	1.21
5	42,363	54,769	1.29	201,842	265,484	1.32	8,081	7,921	.98	67,327	86,427	1.28	9,024	5,536	.61	136,308	151,117	1.11
Totals	214,420	372,587	1.74	846,089	1,316,444	1.56	38,944	38,317	.98	143,254	188,816	1.32	64,639	49,892	.77	1,491,402	1,876,072	1.26
2003																		
1	2,260	3,237	1.43	31,591	45,476	1.44	5,649	4,257	.75	839	778	.93	10,641	5,751	.54	184,070	177,294	.96
2	1,363	930	.68	43,078	50,765	1.18	4,352	3,659	.84	24,628	29,815	1.21	594	251	.42	47,389	53,390	1.13
3	156,530	267,136	1.71	331,063	503,489	1.52	28,148	25,065	.89	28,668	38,911	1.36	49,694	36,793	.74	920,496	1,065,806	1.16
4	10,240	13,600	1.33	136,095	198,494	1.46	8,313	8,448	1.02	15,726	19,700	1.25	21,318	13,773	.65	184,302	206,816	1.12
5	44,433	50,458	1.14	192,626	266,588	1.38	16,136	16,735	1.04	57,229	77,069	1.35	12,339	7,157	.58	134,169	157,801	1.18
Totals	214,826	335,361	1.56	734,453	1,064,812	1.45	62,598	58,164	.93	127,090	166,273	1.31	94,586	63,725	.67	1,470,426	1,661,107	1.13

Table 5. Average regional precipitation and irrigation water use in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.

[Precipitation data from National Oceanic and Atmospheric Administration (1895–2005). Water-use data from Kansas Water Office and Kansas Department of Agriculture (1993–2005)]

Groundwater Management District (GMD) number (fig. 1)	Average regional precipitation (inches)	Total irrigation water use	
		Acre-feet	Percentage of total for all GMDs
1991			
1	19.84	355,589	8.4
2	22.72	112,604	2.7
3	18.19	2,660,233	63.1
4	22.67	478,854	11.4
5	22.72	606,672	14.4
Totals		4,213,952	100
1992			
1	24.16	270,143	8.7
2	31.96	57,195	1.8
3	19.69	2,178,273	70.2
4	25.39	268,217	8.6
5	31.96	330,406	10.6
Totals		3,104,234	100
1993			
1	28.72	197,600	7.3
2	34.08	59,150	2.2
3	24.11	1,887,823	69.6
4	30.09	261,648	9.6
5	34.08	308,474	11.4
Totals		2,714,695	100
1994			
1	18.83	281,921	7.9
2	22.06	100,583	2.8
3	18.87	2,239,152	62.5
4	20.70	396,603	11.1
5	22.06	565,785	15.8
Totals		3,584,044	100
1995			
1	21.55	258,857	7.9
2	31.66	84,940	2.6
3	18.45	2,109,913	64.5
4	22.90	361,778	11.1
5	31.66	453,515	13.9
Totals		3,269,003	100
1996			
1	25.40	250,042	8.3
2	32.01	86,645	2.9
3	25.58	1,949,992	64.5
4	25.85	364,688	12.1
5	32.01	371,749	12.3
Totals		3,023,116	100

Table 5. Average regional precipitation and irrigation water use in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Precipitation data from National Oceanic and Atmospheric Administration (1895–2004). Water-use data from Kansas Water Office and Kansas Department of Agriculture (1993–2005)]

Groundwater Management District (GMD) number (fig. 1)	Average regional precipitation (inches)	Total irrigation water use	
		Acre-feet	Percentage of total for all GMDs
1997			
1	23.51	225,872	7.8
2	34.39	76,457	2.6
3	23.68	1,851,794	63.7
4	19.98	413,066	14.2
5	34.39	341,855	11.8
Totals		2,909,044	100
1998			
1	21.11	223,389	7.1
2	30.14	100,825	3.2
3	20.89	1,940,161	61.6
4	20.87	376,852	12.0
5	30.14	511,214	16.2
Totals		3,152,441	100
1999			
1	21.42	219,915	7.7
2	32.17	85,121	3.0
3	20.36	1,759,432	61.5
4	21.73	331,370	11.6
5	32.17	463,473	16.2
Totals		2,859,311	100
2000			
1	19.64	275,750	7.9
2	32.76	112,448	3.2
3	18.82	2,117,282	60.4
4	17.38	472,688	13.5
5	32.76	528,801	15.1
Totals		3,506,969	100
2001			
1	19.93	226,216	7.0
2	24.87	131,639	4.1
3	18.45	1,889,226	58.7
4	20.48	402,236	12.5
5	24.87	567,745	17.6
Totals		3,217,062	100
2002			
1	13.25	286,707	7.5
2	29.41	125,933	3.3
3	13.43	2,357,519	61.4
4	11.46	500,716	13.0
5	29.41	571,254	14.9
Totals		3,842,129	100

Table 5. Average regional precipitation and irrigation water use in the Groundwater Management Districts within the Kansas High Plains, 1991–2003—Continued

[Precipitation data from National Oceanic and Atmospheric Administration (1895–2004). Water-use data from Kansas Water Office and Kansas Department of Agriculture (1993–2005)]

Groundwater Management District (GMD) number (fig. 1)	Average regional precipitation (inches)	Total irrigation water use	
		Acre-feet	Percentage of total for all GMDs
2003			
1	17.04	236,793	7.1
2	28.41	138,811	4.1
3	17.98	1,937,199	57.8
4	16.06	460,830	13.8
5	28.41	575,807	17.2
Totals		3,349,440	100

Table 6. Trends in precipitation by meteorological regions in Kansas, 1895–2003.

[Trend analysis from Kendall and Gibbons (1990). Shading indicates significant trend at the 95-percent confidence interval]

Region (fig. 1)	Tau	p	Slope	Median (inches)
1895–2003				
1	-0.014	0.836	-0.003	22.55
2	.033	.615	.007	26.24
3	.038	.558	.015	33.71
4	.016	.812	.004	19.54
5	.099	.127	.027	26.45
6	.052	.424	.019	35.97
7	.068	.298	.013	18.48
8	.111	.087	.029	26.92
9	.125	.054	.045	37.21
1950–2003				
1	.094	.321	.040	20.54
2	.013	.899	.005	27.37
3	.078	.408	.065	34.81
4	.066	.483	.028	19.88
5	.088	.351	.057	28.69
6	.097	.303	.073	36.38
7	.091	.336	.036	18.88
8	.185	.185	.101	28.16
9	.185	.049	.159	38.65
1970–2003				
1	-.057	.646	-.026	21.01
2	0	1	0	27.03
3	-.015	.917	-.009	35.33
4	.066	.594	.035	19.95
5	.020	.882	.029	28.69
6	.055	.656	.062	36.93
7	.075	.543	.049	18.88
8	.187	.123	.128	29.09
9	.070	.573	.049	39.23
1980–2003				
1	-.228	.124	-.169	21.01
2	-.043	.785	-.069	26.90
3	-.116	.442	-.179	36.43
4	-.014	.941	-.014	20.08
5	.007	.980	.013	28.93
6	-.080	.602	-.122	37.41
7	.004	1	.003	19.29
8	.174	.244	.130	29.32
9	.007	.980	.005	39.86
1991–2003				
1	-.564	.009	-.839	20.87
2	-.180	.428	-.503	26.24
3	-.231	.300	-.749	34.99
4	-.436	.044	-.672	21.11
5	-.308	.160	-.825	31.17
6	-.179	.428	-.592	37.28
7	-.320	.142	-.390	18.87
8	-.026	.951	-.141	31.66
9	-.205	.360	-.556	40.02

Table 7. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 1, west-central Kansas, 1991–2003.

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Meteorological region 4 precipitation (inches)	Total acres irrigated	Total irrigation water use (acre-ft)	Average rate of irrigation (acre-ft/acre)	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Alfalfa		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	19.84	262,528	355,589	1.35	216,196	299,120	1.38	34,172	39,671	1.16	NA	NA	NA	3,061	4,431	1.45
1992	24.16	244,582	270,143	1.10	188,730	216,103	1.15	30,403	30,008	.99	12,209	13,003	1.07	2,828	4,524	1.60
1993	28.72	223,046	197,600	.89	153,685	141,603	.92	30,312	24,862	.82	21,564	17,978	.83	2,034	2,608	1.28
1994	18.83	236,993	281,921	1.19	152,462	183,734	1.21	35,593	41,356	1.16	24,495	26,488	1.08	3,015	3,990	1.32
1995	21.55	242,512	258,857	1.07	136,550	155,854	1.14	41,565	40,900	.98	33,328	32,913	.99	1,944	2,992	1.54
1996	25.40	242,642	250,042	1.03	123,648	131,803	1.07	48,318	46,961	.97	42,166	41,796	.99	2,902	3,458	1.19
1997	23.51	246,497	225,872	.92	106,858	105,247	.98	41,150	33,529	.81	69,341	60,145	.87	2,967	3,472	1.17
1998	21.11	244,883	223,389	.91	86,245	81,677	.95	44,591	37,746	.85	79,805	75,122	.94	2,859	3,486	1.22
1999	21.42	246,636	219,915	.89	77,205	75,953	.98	40,196	33,389	.83	93,569	79,546	.85	2,555	3,430	1.34
2000	19.64	250,274	275,750	1.10	66,913	75,083	1.12	27,605	27,129	.98	119,262	131,780	1.10	2,266	3,117	1.38
2001	19.93	237,016	226,216	.95	52,491	53,405	1.02	29,663	26,016	.88	120,284	115,239	.96	2,380	4,181	1.76
2002	13.25	243,617	286,707	1.18	51,732	61,436	1.19	23,716	26,216	1.11	123,104	147,330	1.20	2,521	3,996	1.58
2003	17.04	235,050	236,793	1.01	47,292	49,659	1.05	18,770	17,394	.93	132,831	132,349	1.00	2,260	3,237	1.43
Average	21.11	242,790	254,523	1.05	112,308	125,437	1.09	34,312	32,706	.96	72,633	72,807	.99	2,584	3,609	1.40
Minimum	13.25	223,046	197,600	.89	47,292	49,659	.92	18,770	17,394	.81	12,209	13,003	.83	1,944	2,608	1.17
Maximum	28.72	262,528	355,589	1.35	216,196	299,120	1.38	48,318	46,961	1.16	132,831	147,330	1.20	3,061	4,524	1.76
Median	21.11	243,617	250,042	1.03	106,858	105,247	1.07	34,172	33,389	.97	74,573	67,634	.99	2,555	3,472	1.38
Slope	-.67	-46	-3,252	-.015	-14,042	-15,916	-.0106	-790	-1,428	-.0055	12,004	12,158	.004	-50.7	-34.8	.012
p-value	.044	1.000	.502	.358	0	0	.392	.161	.044	.426	0	0	.582	.100	.669	.583

Table 7. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 1, west-central Kansas, 1991–2003.—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Corn			Grain sorghum			Soybeans			Wheat			Other/multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	41,584	64,116	1.54	15,576	18,257	1.17	301	431	1.43	7,655	5,800	0.76	194,351	262,554	1.35
1992	48,455	62,838	1.30	12,940	11,602	.90	916	1,003	1.10	7,974	5,652	.71	171,469	184,524	1.08
1993	58,762	64,761	1.10	9,997	7,270	.73	67	17	.26	5,459	2,409	.44	146,727	120,534	.82
1994	50,703	73,305	1.45	10,029	8,526	.85	317	403	1.27	4,566	2,477	.54	168,363	193,220	1.15
1995	54,699	68,045	1.24	9,488	8,107	.85	0	0	0	7,371	5,126	.70	169,010	174,586	1.03
1996	66,332	82,493	1.24	9,267	6,801	.73	118	82	.69	4,597	2,082	.45	159,426	155,127	.97
1997	69,309	76,172	1.10	7,183	4,226	.59	544	416	.76	9,338	5,386	.58	157,156	136,200	.87
1998	69,902	79,262	1.13	2,960	1,659	.56	1,362	1,027	.75	6,647	4,429	.67	161,153	133,526	.83
1999	68,483	74,841	1.09	3,181	2,672	.84	1,462	1,612	1.10	5,492	2,454	.45	165,463	134,906	.82
2000	68,448	94,918	1.39	2,494	2,221	.89	1,600	1,499	.94	6,651	4,168	.63	168,815	169,827	1.01
2001	54,499	66,954	1.23	5,128	3,636	.71	1,189	1,203	1.01	5,351	2,524	.47	168,469	147,718	.88
2002	47,875	75,844	1.58	4,553	5,068	1.11	1,520	1,550	1.02	5,613	4,289	.76	181,535	195,960	1.08
2003	31,591	45,476	1.44	5,649	4,257	.75	839	778	.93	10,641	5,751	.54	184,070	177,294	.96
Average	56,203	71,463	1.29	7,573	6,485	.82	787	771	.87	6,720	4,042	.59	168,924	168,152	.99
Minimum	31,591	45,476	1.09	2,494	1,659	.71	0	0	0	4,566	2,082	.44	146,727	120,534	.82
Maximum	69,902	94,918	1.58	15,576	18,257	1.17	1,600	1,612	1.43	10,641	5,800	.76	194,351	262,554	1.35
Median	54,699	73,305	1.24	7,183	5,068	.84	839	778	.94	6,647	4,289	.58	168,469	169,827	.97
Slope	582	1,024	-.0005	-833	-771	-.0098	103	92.1	-.0016	3.75	-19.8	-.0067	1,324	-1,625	-.0173
p-value	.760	.300	.951	.002	.009	.358	.033	.059	1.000	.951	.855	.713	.502	.669	.245

Table 7. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 1, west-central Kansas, 1991–2003.—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Total acres irrigated					
	Prorated alfalfa	Prorated corn	Prorated grain sorghum	Prorated soybeans	Prorated wheat	Other prorated, unspecified
1991	18,862	120,982	44,807	301	55,452	22,124
1992	10,258	101,980	41,191	7,218	66,767	17,168
1993	7,869	111,027	28,153	2,284	59,130	14,583
1994	9,632	110,004	29,460	3,729	68,482	15,687
1995	9,116	115,964	27,816	1,408	69,982	18,226
1996	8,707	123,898	31,552	3,462	57,281	17,742
1997	7,291	132,274	24,597	5,782	67,264	9,288
1998	11,128	128,234	14,695	13,215	59,377	18,234
1999	7,485	131,867	14,839	10,560	62,341	19,544
2000	6,086	133,715	9,369	12,099	70,411	18,594
2001	5,491	115,679	17,576	11,217	66,808	20,186
2002	5,183	115,246	23,284	8,449	76,414	15,041
2003	5,719	89,352	22,681	9,930	78,208	29,161
Average	8,679	117,709	25,386	6,896	65,994	18,121
Minimum	5,183	89,352	9,369	301	55,452	9,288
Maximum	18,862	133,715	44,807	13,215	78,208	29,161
Median	7,869	115,964	24,597	7,218	66,808	18,226
Slope	-485	732	-1,900	852	1,076	328
p-value	.001	.128	.006	.024	.0173	.2001

Table 8. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Ground Water Management District 2, south-central Kansas, 1991–2003.

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Meteorological region 8 precipitation (inches)	Total acres irrigated	Total irrigation water use (acre-ft)	Average rate of irrigation (acre-ft/acre)	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Alfalfa		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	22.72	97,833	112,604	1.15	37,604	47,438	1.26	52,475	57,681	1.10	NA	NA	NA	1,311	1,173	0.90
1992	31.96	92,880	57,195	.62	33,125	22,523	.68	52,029	30,556	.59	1,608	619	.38	1,730	1,077	.62
1993	34.08	90,525	59,150	.65	31,261	22,283	.71	52,474	33,068	.63	1,048	711	.68	1,000	507	.51
1994	22.06	97,243	100,583	1.03	33,648	38,253	1.14	53,525	52,899	.99	1,108	872	.79	1,179	1,382	1.17
1995	31.66	97,814	84,940	.87	31,246	29,015	.93	56,895	48,279	.85	1,669	1,094	.66	1,178	717	.61
1996	32.01	103,597	86,645	.84	29,702	28,537	.96	63,406	50,110	.79	2,289	1,924	.84	1,195	847	.71
1997	34.39	106,771	76,457	.72	27,709	22,793	.82	42,920	29,687	.69	28,158	18,578	.66	1,376	887	.64
1998	30.14	110,441	100,825	.91	26,502	27,643	1.04	39,608	32,975	.83	32,294	29,975	.93	1,656	1,527	.92
1999	32.17	114,635	85,121	.74	26,588	22,574	.85	35,230	24,622	.70	42,404	30,645	.72	1,248	883	.71
2000	32.76	116,186	112,448	.97	26,875	30,136	1.12	25,159	21,843	.87	52,818	50,443	.96	918	934	1.02
2001	24.87	117,476	131,639	1.12	25,419	31,743	1.25	25,522	26,152	1.02	54,087	60,227	1.11	1,365	1,089	.80
2002	29.41	120,840	125,933	1.04	24,826	30,690	1.24	20,090	20,116	1.00	61,401	61,132	1.00	1,495	1,321	.88
2003	28.41	121,404	138,811	1.14	22,520	29,566	1.31	19,362	21,060	1.09	63,854	70,842	1.11	1,363	930	.68
Average	29.74	106,742	97,873	.91	29,002	29,476	1.02	41,438	34,542	.86	28,562	27,255	.82	1,309	1,021	.78
Minimum	22.06	90,525	57,195	.62	22,520	22,283	.68	19,362	20,116	.59	1,048	619	.38	918	507	.51
Maximum	34.39	121,404	138,811	1.15	37,604	47,438	1.31	63,406	57,681	1.10	63,854	70,842	1.11	1,730	1,527	1.17
Median	31.66	106,771	100,583	.91	27,709	29,015	1.04	42,920	30,556	.85	30,226	24,277	.82	1,311	934	.71
Slope	-.14	2,843	6,066	.0312	-1,020	98.2	.04	-3,363	-2,457	.0248	6,677	7,143	.05	15.3	14.6	.013
p-value	.951	0	.012	.100	0	.669	.059	.003	.002	.127	0	0	.002	.583	.502	.463

Table 8. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Ground Water Management District 2, south-central Kansas, 1991–2003.—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Corn			Grain sorghum			Soybeans			Wheat			Other/multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	22,721	29,650	1.30	7,304	5,589	0.77	13,733	15,487	1.13	721	418	0.58	52,043	60,286	1.16
1992	19,827	11,723	.59	8,719	4,837	.55	13,589	9,599	.71	927	329	.36	48,088	29,629	.62
1993	20,270	14,016	.69	4,813	2,213	.46	12,330	9,371	.76	633	114	.18	51,479	32,928	.64
1994	21,342	24,224	1.14	4,076	3,498	.86	16,155	17,032	1.05	802	213	.27	53,689	54,234	1.01
1995	20,084	19,902	.99	7,060	4,822	.68	15,803	14,032	.89	1,227	393	.32	52,462	45,075	.86
1996	24,474	24,680	1.01	5,578	3,615	.65	15,063	11,988	.80	1,490	489	.33	55,797	45,027	.81
1997	26,924	21,082	.78	3,876	2,174	.56	21,919	15,898	.73	1,401	424	.30	51,275	35,993	.70
1998	27,370	25,714	.94	3,698	2,576	.70	24,134	23,689	.98	1,012	476	.47	52,571	46,844	.89
1999	30,616	22,628	.74	2,993	1,768	.59	29,126	22,773	.78	684	239	.35	49,968	36,830	.74
2000	28,112	25,284	.90	2,816	1,929	.69	33,760	36,285	1.07	729	250	.34	49,851	47,766	.96
2001	30,904	34,676	1.12	3,134	2,722	.87	31,783	36,951	1.16	1,194	663	.55	49,096	55,537	1.13
2002	35,974	38,735	1.08	3,356	2,523	.75	29,202	31,773	1.09	635	408	.64	50,178	51,173	1.02
2003	43,078	50,765	1.18	4,352	3,659	.84	24,628	29,815	1.21	594	251	.42	47,389	53,390	1.13
Average	27,054	26,391	.96	4,752	3,225	.69	21,633	21,130	.95	927	359	.39	51,068	45,747	.90
Minimum	19,827	11,723	.59	2,816	1,768	.46	12,330	9,371	.71	594	114	.18	47,389	29,629	.62
Maximum	43,078	50,765	1.30	8,719	5,589	.87	33,760	36,951	1.21	1,490	663	.64	55,797	60,286	1.16
Median	26,924	24,680	.99	4,076	2,722	.69	21,919	17,032	.98	802	393	.35	51,275	46,844	.89
Slope	1,524	2,146	.0218	-320	-186	.017	1,747	2,095	.0292	-14.2	5.68	.0163	-296	1,026	.0312
p-value	0	.006	.428	.009	.127	.161	.002	.004	.410	.502	.502	.127	.100	.282	.112

Table 8. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Ground Water Management District 2, south-central Kansas, 1991–2003.—Continued

[Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Total acres irrigated					
	Prorated alfalfa	Prorated corn	Prorated grain sorghum	Prorated soybeans	Prorated wheat	Other prorated, unspecified
1991	1,311	22,721	7,304	13,733	721	1,438
1992	3,306	34,526	16,888	32,106	3,715	2,315
1993	3,304	38,062	11,240	33,490	2,132	2,296
1994	2,885	40,638	10,468	37,519	2,845	2,888
1995	2,841	37,541	14,458	36,728	4,371	1,875
1996	3,373	43,140	13,671	35,182	6,392	1,839
1997	3,091	45,876	8,375	42,487	5,060	1,881
1998	3,124	46,780	7,409	45,637	3,462	4,028
1999	3,059	47,669	6,674	48,955	3,399	4,878
2000	2,067	46,654	6,462	54,219	2,678	4,107
2001	2,415	47,952	6,453	51,239	3,951	5,466
2002	2,819	52,636	7,716	48,063	4,757	4,849
2003	2,757	59,169	8,441	42,448	3,139	5,450
Average	2,796	43,336	9,658	40,139	3,586	3,332
Minimum	1,311	22,721	6,453	13,733	721	1,438
Maximum	3,373	59,169	16,888	54,219	6,392	5,466
Median	2,885	45,876	8,375	42,448	3,462	2,888
Slope	-43.5	1,850	-618	2233	132	324
p-value	.200	0	.059	.002	.428	.004

Table 9. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 3, southwest Kansas, 1991–2003.

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Meteorological region 7 precipitation (inches)	Total acres irrigated	Total irrigation water use (acre-ft)	Average rate of irrigation (acre-ft/acre)	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Alfalfa		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	18.19	1,593,191	2,660,233	1.67	823,757	1,417,562	1.72	604,248	974,993	1.61	NA	NA	NA	112,077	227,401	2.03
1992	19.69	1,580,084	2,178,273	1.38	783,385	1,120,560	1.43	574,112	773,720	1.35	52,305	62,683	1.20	104,396	175,814	1.68
1993	24.11	1,550,396	1,887,823	1.22	688,521	859,444	1.25	601,448	740,184	1.23	56,285	62,973	1.12	103,698	162,041	1.56
1994	18.87	1,555,565	2,239,152	1.44	602,004	903,099	1.50	609,548	868,895	1.43	88,960	124,034	1.39	109,133	199,017	1.82
1995	18.45	1,533,409	2,109,913	1.38	486,039	708,401	1.46	657,248	882,965	1.34	93,271	125,052	1.34	114,411	193,784	1.69
1996	25.58	1,524,257	1,949,992	1.28	442,764	597,295	1.35	684,371	857,864	1.25	113,215	141,655	1.25	108,819	168,783	1.55
1997	23.68	1,576,430	1,851,794	1.17	355,973	431,904	1.21	516,487	623,105	1.21	393,274	465,788	1.18	124,470	202,750	1.63
1998	20.89	1,583,403	1,940,161	1.23	280,187	326,765	1.17	481,008	619,532	1.29	474,580	599,184	1.26	136,561	233,416	1.71
1999	20.36	1,594,865	1,759,432	1.10	239,048	259,471	1.09	409,610	468,742	1.14	586,912	663,830	1.13	130,184	185,079	1.42
2000	18.82	1,584,541	2,117,282	1.34	207,349	265,080	1.28	327,109	444,594	1.36	716,366	995,219	1.39	122,033	222,914	1.83
2001	18.45	1,552,436	1,889,226	1.22	163,657	187,146	1.14	277,253	338,657	1.22	771,727	974,471	1.26	144,614	240,336	1.66
2002	13.43	1,594,975	2,357,519	1.48	150,509	234,006	1.55	238,835	347,155	1.45	818,106	1,238,698	1.51	159,240	298,900	1.88
2003	17.98	1,514,599	1,937,199	1.28	112,449	144,707	1.29	215,483	266,573	1.24	842,524	1,094,106	1.30	156,530	267,136	1.71
Average	19.88	1,564,473	2,067,538	1.32	410,434	573,495	1.34	476,674	631,306	1.32	417,294	545,641	1.28	125,090	213,644	1.71
Minimum	13.43	1,514,599	1,759,432	1.10	112,449	144,707	1.09	215,483	266,573	1.14	52,305	62,683	1.12	103,698	162,041	1.42
Maximum	25.58	1,594,975	2,660,233	1.67	823,757	1,417,562	1.72	684,371	974,993	1.61	842,524	1,238,698	1.51	159,240	298,900	2.03
Median	18.87	1,576,430	1,949,992	1.28	355,973	431,904	1.29	516,487	623,105	1.29	433,927	532,486	1.26	122,033	202,750	1.69
Slope	-.39	99.4	-21,752	-.017	-62,954	-94,647	-.025	-38,507	-58,984	-.012	84,806	117,084	.01	4,884	7,368	.002
p-value	.142	.026	.246	.269	0	0	.127	.002	0	.300	0	0	.241	.001	.017	.903

Table 9. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 3, southwest Kansas, 1991–2003.—Continued

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Corn			Grain sorghum			Soybeans			Wheat			Other/multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	186,557	356,541	1.91	49,141	72,187	1.47	9,440	14,308	1.52	82,560	90,641	1.10	1,153,416	1,899,155	1.65
1992	217,375	336,529	1.55	42,784	39,958	.93	10,676	10,342	.97	79,339	81,315	1.02	1,125,514	1,534,314	1.36
1993	259,940	390,866	1.50	26,218	21,496	.82	6,799	6,715	.99	68,829	55,768	.81	1,084,912	1,250,936	1.15
1994	277,076	464,174	1.68	20,143	20,990	1.04	6,735	9,086	1.35	59,655	56,857	.95	1,082,823	1,489,030	1.38
1995	278,912	450,640	1.62	20,033	19,878	.99	4,709	6,199	1.32	49,554	39,819	.80	1,065,790	1,399,593	1.31
1996	331,052	489,911	1.48	20,459	16,720	.82	4,855	4,083	.84	36,924	30,617	.83	1,022,148	1,239,878	1.21
1997	381,109	506,695	1.33	19,094	15,927	.83	6,724	7,227	1.07	38,921	29,771	.76	1,006,112	1,089,424	1.08
1998	410,369	602,187	1.47	9,130	6,924	.76	12,184	15,819	1.30	33,583	25,253	.75	981,576	1,056,562	1.08
1999	422,801	565,797	1.34	11,114	8,320	.75	21,090	21,963	1.04	37,965	23,033	.61	971,711	955,240	.98
2000	454,130	720,060	1.59	9,357	8,154	.87	25,365	36,181	1.43	37,045	28,325	.76	936,611	1,101,647	1.18
2001	407,355	584,300	1.43	11,656	9,978	.86	30,733	43,979	1.43	53,006	36,850	.70	905,072	973,783	1.08
2002	382,199	673,482	1.76	18,561	18,252	.98	26,349	42,690	1.62	40,498	33,603	.83	968,128	1,290,592	1.33
2003	331,063	503,489	1.52	28,148	25,065	.89	28,668	38,911	1.36	49,694	36,793	.74	920,496	1,065,806	1.16
Average	333,841	511,129	1.55	21,988	21,835	.92	14,948	19,808	1.25	51,352	43,742	.82	1,017,255	1,257,382	1.23
Minimum	186,557	336,529	1.33	9,130	6,924	.75	4,709	4,083	.84	33,583	23,033	.61	905,072	955,240	.98
Maximum	454,130	720,060	1.91	49,141	72,187	1.47	30,733	43,979	1.62	82,560	90,641	1.10	1,153,416	1,899,155	1.65
Median	331,063	503,489	1.52	20,033	18,252	.87	10,676	14,308	1.32	49,554	36,793	.80	1,006,112	1,239,878	1.18
Slope	21,980	28,408	-.0133	-1,813	-1,940	-.0108	2,011	3,213	.02	-2,940	-3,983	-.0239	-21,939	-53,651	.026
p-value	.0018	.0012	.300	.033	.033	.392	.017	.024	.179	.059	.017	.006	0	.006	.065

Table 9. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 3, southwest Kansas, 1991–2003.—Continued

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Total acres irrigated					
	Prorated alfalfa	Prorated corn	Prorated grain sorghum	Prorated soybeans	Prorated wheat	Other prorated, unspecified
1991	112,077	618,784	295,696	9,440	514,787	42,407
1992	143,999	580,205	217,329	64,803	507,719	59,639
1993	144,543	661,461	147,899	49,100	508,370	36,812
1994	149,518	683,368	135,429	44,789	500,057	42,404
1995	158,070	680,288	123,904	38,817	479,276	52,405
1996	155,038	719,069	137,261	28,719	438,073	45,702
1997	173,314	775,920	111,611	30,728	443,212	40,549
1998	188,807	788,317	84,059	47,241	409,832	65,148
1999	179,036	791,832	83,715	73,544	394,238	72,500
2000	166,767	812,764	72,984	84,988	377,381	69,658
2001	186,846	728,078	84,338	98,678	368,669	85,828
2002	211,179	708,406	116,404	78,134	377,889	102,964
2003	210,287	622,657	141,593	73,613	365,540	100,909
Average	167,652	705,473	134,786	55,584	437,311	62,840
Minimum	112,077	580,205	72,984	9,440	365,540	36,812
Maximum	211,179	812,764	295,696	98,678	514,787	102,964
Median	166,767	708,406	123,904	49,100	438,073	59,639
Slope	6,646	12,608	-10,375	4,738	-14,611	5,629
p-value	0	.044	.0173	.0327	0	.003

Table 10. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 4, northwest Kansas, 1991–2003.

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Meteorological region 1 precipitation (inches)	Total acres irrigated	Total irrigation water use (acre-ft)	Average rate of irrigation (acre-ft/yr)	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Alfalfa		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	22.67	360,109	478,854	1.33	111,066	173,659	1.56	218,417	263,077	1.20	NA	NA	NA	6,383	9,317	1.46
1992	25.39	340,522	268,217	.79	83,917	82,776	.99	186,421	133,135	.71	43,379	31,187	.72	5,237	4,765	.91
1993	30.09	343,660	261,648	.76	77,960	79,034	1.01	180,509	127,103	.70	60,882	38,516	.63	6,289	4,808	.76
1994	20.70	367,070	396,603	1.08	74,031	97,211	1.31	184,188	191,807	1.04	73,774	73,634	1.00	5,676	5,800	1.02
1995	22.90	355,259	361,778	1.02	60,157	73,850	1.23	195,033	193,008	.99	74,158	69,698	.94	7,402	7,129	.96
1996	25.85	370,641	364,688	.98	52,973	62,599	1.18	199,944	192,755	.96	85,604	78,055	.91	7,200	6,499	.90
1997	19.98	381,935	413,066	1.08	44,908	54,950	1.22	136,971	142,795	1.04	170,738	184,679	1.08	8,309	9,095	1.09
1998	20.87	380,712	376,852	.99	32,801	36,220	1.10	104,022	101,738	.98	212,541	209,301	.98	9,299	10,419	1.12
1999	21.73	378,827	331,370	.87	26,988	28,555	1.06	95,372	80,905	.85	219,918	189,915	.86	9,552	8,836	.93
2000	17.38	374,945	472,688	1.26	20,792	30,969	1.49	70,750	86,909	1.23	250,894	316,092	1.26	7,897	9,928	1.26
2001	20.48	367,627	402,236	1.09	16,830	20,649	1.23	57,955	64,016	1.10	260,665	281,731	1.08	8,702	11,094	1.27
2002	11.46	374,371	500,716	1.34	14,672	22,270	1.52	50,587	66,332	1.31	275,019	368,947	1.34	8,801	13,601	1.55
2003	16.06	375,994	460,830	1.23	11,610	16,227	1.40	49,425	57,226	1.16	283,226	349,235	1.23	10,240	13,600	1.33
Average	21.20	367,052	391,504	1.06	48,362	59,921	1.25	133,046	130,831	1.02	167,567	182,583	1.00	7,768	8,838	1.12
Minimum	11.46	340,522	261,648	.76	11,610	16,227	.99	49,425	57,226	.70	43,379	31,187	.63	5,237	4,765	.76
Maximum	30.09	381,935	500,716	1.34	111,066	173,659	1.56	218,417	263,077	1.31	283,226	368,947	1.34	10,240	13,601	1.55
Median	20.87	370,641	396,603	1.08	44,908	54,950	1.23	136,971	127,103	1.04	191,640	187,297	.99	7,897	9,095	1.09
Slope	-.84	2,330	12,531	.03	-7,837	-7,752	.0191	-15,115	-14,607	.0282	24,366	33,764	.05	355	782	.04
p-value	.009	.044	.100	.321	0	0	.328	0	.001	.346	0	0	.013	.001	.001	.033

Table 10. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 4, northwest Kansas, 1991–2003.—Continued

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Corn			Grain sorghum			Soybeans			Wheat			Other/multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	140,359	212,020	1.51	23,474	28,699	1.22	5,604	6,630	1.18	15,816	11,209	0.71	168,473	210,980	1.25
1992	139,908	119,470	.85	28,445	20,129	.71	6,996	4,705	.67	15,184	8,169	.54	144,752	110,979	.77
1993	164,651	139,859	.85	6,759	3,405	.50	4,489	2,536	.57	16,204	7,811	.48	145,268	103,228	.71
1994	177,265	218,340	1.23	7,125	5,941	.83	3,929	3,709	.94	11,625	6,803	.59	161,450	156,009	.97
1995	158,766	195,690	1.23	8,364	7,067	.84	3,576	3,495	.98	17,480	8,001	.46	159,671	140,396	.88
1996	204,159	224,076	1.10	6,333	4,133	.65	2,504	2,264	.90	13,580	7,217	.53	136,865	120,498	.88
1997	222,164	265,040	1.19	5,745	4,360	.76	6,348	6,523	1.03	13,982	8,530	.61	125,387	119,518	.95
1998	219,731	240,991	1.10	4,483	2,998	.67	10,096	8,950	.89	9,518	5,203	.55	127,585	108,291	.85
1999	215,832	209,552	.97	3,479	2,196	.63	12,014	9,166	.76	11,810	6,000	.51	126,140	95,620	.76
2000	215,444	298,766	1.39	2,526	2,126	.84	15,063	18,755	1.25	9,165	5,391	.59	124,850	137,721	1.10
2001	185,803	233,083	1.25	6,159	5,871	.95	19,852	21,553	1.09	12,662	6,726	.53	134,449	123,908	.92
2002	178,199	262,899	1.48	4,393	4,553	1.04	18,856	26,376	1.40	8,869	6,056	.68	155,253	187,230	1.21
2003	136,095	198,494	1.46	8,313	8,448	1.02	15,726	19,700	1.25	21,318	13,773	.65	184,302	206,816	1.12
Average	181,414	216,791	1.20	8,892	7,687	.82	9,619	10,336	.99	13,632	7,761	.57	145,727	140,092	.95
Minimum	136,095	119,470	.85	2,526	2,126	.50	2,504	2,264	.57	8,869	5,203	.46	124,850	95,620	.71
Maximum	222,164	298,766	1.51	28,445	28,699	1.22	19,852	26,376	1.40	21,318	13,773	.71	184,302	210,980	1.25
Median	178,199	218,340	1.23	6,333	4,553	.83	6,996	6,630	.98	13,580	7,217	.55	144,752	123,908	.92
Slope	3,634	6,351	.0306	-694	-547	.022	1,389	1,736	.039	-426	-211	.0067	-1,359	1,267	.022
p-value	.4277	.0768	.177	.017	.200	.271	.012	.006	.067	.161	.200	.501	.360	.760	.32

Table 10. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 4, northwest Kansas, 1991–2003.—Continued

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Total acres irrigated					
	Prorated alfalfa	Prorated corn	Prorated grain sorghum	Prorated soybeans	Prorated wheat	Other prorated, unspecified
1991	6,383	140,359	23,474	5,604	15,816	12,615
1992	9,789	190,406	40,418	18,279	47,507	34,124
1993	10,619	216,276	12,412	15,016	49,043	40,293
1994	10,680	233,777	13,749	12,615	45,981	50,268
1995	11,843	209,783	16,093	11,148	48,370	58,022
1996	13,805	255,858	15,452	8,851	45,665	31,009
1997	13,904	268,921	11,708	15,719	44,398	27,285
1998	16,467	266,057	9,282	24,606	37,293	27,007
1999	16,161	257,917	6,921	25,968	35,943	35,917
2000	13,889	260,474	4,729	33,642	34,192	28,020
2001	14,260	230,022	9,784	37,926	40,338	35,298
2002	15,838	234,348	10,409	47,459	42,142	24,175
2003	17,613	193,409	18,107	43,128	67,008	36,729
Average	13,173	227,508	14,811	23,074	42,592	33,905
Minimum	6,383	140,359	4,729	5,604	15,816	12,615
Maximum	17,613	268,921	40,418	47,459	67,008	58,022
Median	13,889	233,777	12,412	18,279	44,398	34,124
Slope	777	4,397	-1,107	3,197	-532	-332
p-value	0	.200	.0585	.0012	.502	.855

Table 11. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 5, south-central Kansas, 1991–2003.

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available

Year	Meteorological region 8 precipitation (inches)	Total acres irrigated	Total irrigation water use (acre-ft)	Average	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle			Alfalfa		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	22.72	434,745	606,672	1.40	66,906	98,928	1.48	358,046	494,995	1.38	NA	NA	NA	47,721	68,609	1.44
1992	31.96	418,749	330,406	.79	53,548	34,700	.65	342,227	278,906	.81	15,919	11,997	.75	42,745	37,283	.87
1993	34.08	410,330	308,474	.75	48,087	27,207	.57	346,260	268,263	.77	8,495	8,095	.95	40,900	28,089	.69
1994	22.06	428,022	565,785	1.32	56,293	73,273	1.30	352,781	469,318	1.33	9,305	12,269	1.32	41,386	56,319	1.36
1995	31.66	426,810	453,515	1.06	57,069	56,766	.99	348,025	375,065	1.08	14,367	14,473	1.01	40,244	37,877	.94
1996	32.01	431,379	371,749	.86	49,876	41,465	.83	355,894	309,488	.87	18,249	15,647	.86	37,692	29,566	.78
1997	34.39	439,038	341,855	.78	46,642	34,089	.73	269,480	211,070	.78	115,490	91,938	.80	37,009	27,488	.74
1998	30.14	448,803	511,214	1.14	43,939	41,606	.95	219,963	254,895	1.16	167,639	194,692	1.16	36,064	41,255	1.14
1999	32.17	457,878	463,473	1.01	42,592	35,707	.84	209,721	217,124	1.04	189,085	195,702	1.03	36,481	32,904	.90
2000	32.76	458,336	528,801	1.15	38,213	41,422	1.08	174,385	204,296	1.17	229,741	265,459	1.16	30,025	34,944	1.16
2001	24.87	462,003	567,745	1.23	39,014	41,734	1.07	143,220	176,108	1.23	258,986	325,155	1.26	32,947	39,317	1.19
2002	29.41	464,945	571,254	1.23	35,692	39,650	1.11	118,264	145,967	1.23	290,459	360,588	1.24	42,363	54,769	1.29
2003	28.41	456,932	575,807	1.26	30,817	39,546	1.28	99,141	126,458	1.28	307,325	385,951	1.26	44,433	50,458	1.14
Average	29.74	441,382	476,673	1.08	46,822	46,623	.99	256,724	271,689	1.09	135,422	156,831	1.07	39,232	41,452	1.05
Minimum	22.06	410,330	308,474	.75	30,817	27,207	.57	99,141	126,458	.77	8,495	8,095	.75	30,025	27,488	.69
Maximum	34.39	464,945	606,672	1.40	66,906	98,928	1.48	358,046	494,995	1.38	307,325	385,951	1.32	47,721	68,609	1.44
Median	31.66	439,038	511,214	1.14	46,642	41,422	.99	269,480	254,895	1.16	141,565	143,315	1.10	40,244	37,877	1.14
Slope	-.14	4,617	16,244	.028	-2,630	-357	.04	-25,018	-26,280	.025	31,401	39,898	.03	-970	366	.025
p-value	.951	.001	.059	.222	0	.502	.246	0	0	.222	0	0	.033	.059	.077	.463

Table 11. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 5, south-central Kansas, 1991–2003.—Continued

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Corn			Grain sorghum			Soybeans			Wheat			Other/multiple use		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	158,182	232,206	1.47	18,691	21,402	1.15	29,079	40,321	1.39	15,114	10,958	0.73	165,958	233,176	1.41
1992	180,103	152,136	.84	18,262	9,483	.52	21,307	16,609	.78	14,586	7,734	.53	141,746	107,162	.76
1993	184,608	158,642	.86	12,528	5,227	.42	23,824	18,912	.79	11,746	3,497	.30	136,724	94,107	.69
1994	189,124	264,327	1.40	11,889	11,158	.94	29,119	38,466	1.32	7,308	5,613	.77	149,196	189,901	1.27
1995	185,095	221,508	1.20	14,059	10,447	.74	28,128	31,444	1.12	10,071	4,496	.45	149,213	147,743	.99
1996	210,359	200,650	.95	14,229	8,771	.62	31,627	25,044	.79	5,985	2,522	.42	131,487	105,197	.80
1997	200,050	170,569	.85	10,588	6,042	.57	54,749	42,507	.78	6,481	2,322	.36	130,161	92,926	.71
1998	203,016	245,091	1.21	7,602	5,766	.76	66,447	78,408	1.18	5,238	1,969	.38	130,436	138,726	1.06
1999	197,704	213,070	1.08	6,840	5,358	.78	72,459	80,734	1.11	9,279	4,386	.47	135,115	127,021	.94
2000	207,135	243,038	1.17	6,149	5,302	.86	73,072	91,160	1.25	7,934	4,503	.57	134,021	149,854	1.12
2001	201,073	259,856	1.29	7,112	6,394	.90	67,948	90,203	1.33	9,696	6,164	.64	143,227	165,810	1.16
2002	201,842	265,484	1.32	8,081	7,921	.98	67,327	86,427	1.28	9,024	5,536	.61	136,308	151,117	1.11
2003	192,626	266,588	1.38	16,136	16,735	1.04	57,229	77,069	1.35	12,339	7,157	.58	134,169	157,801	1.18
Average	193,147	222,551	1.16	11,705	9,231	.79	47,870	55,177	1.11	9,600	5,143	.52	139,828	143,119	1.02
Minimum	158,182	152,136	.84	6,149	5,227	.42	21,307	16,609	.78	5,238	1,969	.30	130,161	92,926	.69
Maximum	210,359	266,588	1.47	18,691	21,402	1.15	73,072	91,160	1.39	15,114	10,958	.77	165,958	233,176	1.41
Median	197,704	232,206	1.20	11,889	7,921	.78	54,749	42,507	1.18	9,279	4,503	.53	136,308	147,743	1.06
Slope	2,256	6,448	.03	-901	-342	.042	4,092	5,788	.031	-289	-40	.01	-981	2,924	.024
p-value	.0239	.0173	.256	.033	.360	.410	.003	.006	.159	.360	.855	.583	.2001	.502	.2996

Table 11. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for Groundwater Management District 5, south-central Kansas, 1991–2003.—Continued

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Total acres irrigated					
	Prorated alfalfa	Prorated corn	Prorated grain sorghum	Prorated soybeans	Prorated wheat	Other prorated, unspecified
1991	47,721	158,182	18,691	29,079	15,114	7,861
1992	55,764	214,451	39,003	49,966	44,489	14,457
1993	51,262	225,998	26,430	55,657	35,792	15,156
1994	54,559	234,543	30,455	62,261	32,593	13,611
1995	52,364	229,328	30,637	63,554	36,299	14,629
1996	48,493	250,564	28,744	64,626	26,268	12,684
1997	48,852	237,235	23,958	89,570	26,788	12,634
1998	46,658	242,618	16,866	103,000	21,146	18,515
1999	46,243	238,976	15,353	108,083	26,906	22,318
2000	39,576	247,618	13,849	109,242	27,891	20,160
2001	41,862	241,776	14,994	105,126	31,520	26,725
2002	53,780	238,746	17,000	101,677	29,178	24,564
2003	55,165	223,616	27,714	86,835	37,357	26,245
Average	49,408	229,512	23,361	79,129	30,103	17,658
Minimum	39,576	158,182	13,849	29,079	15,114	7,861
Maximum	55,764	250,564	39,003	109,242	44,489	26,725
Median	48,852	237,235	23,958	86,835	29,178	15,156
Slope	-676	2,118	-1,466	6,161	184	1,367
p-value	.300	.077	.0585	.0012	.760	.004

Table 12. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for all Groundwater Management Districts, Kansas, 1991–2003.

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Average precipitation for meteorological regions 1, 4, 7, and 8 (inches)	Total acres irrigated	Total irrigation water use (acre-ft)	Average rate of irrigation (acre-ft/acre)	Flood irrigation			Center pivot irrigation			Center pivot irrigation with drop nozzle		
					Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	20.86	2,748,406	4,213,952	1.53	1,255,529	2,036,707	1.62	1,267,358	1,830,417	1.44	NA	NA	NA
1992	25.30	2,676,817	3,104,234	1.16	1,142,705	1,476,662	1.29	1,185,192	1,246,325	1.05	125,420	119,489	.95
1993	29.25	2,617,957	2,714,695	1.04	999,514	1,129,571	1.13	1,211,003	1,193,480	.99	148,274	128,273	.87
1994	20.12	2,684,893	3,584,044	1.33	918,438	1,295,570	1.41	1,235,635	1,624,275	1.31	197,642	237,297	1.20
1995	23.64	2,655,804	3,269,003	1.23	771,061	1,023,886	1.33	1,298,766	1,540,217	1.19	216,793	243,230	1.12
1996	27.21	2,672,516	3,023,116	1.13	698,963	861,699	1.23	1,351,933	1,457,178	1.08	261,523	279,077	1.07
1997	25.39	2,750,671	2,909,044	1.06	582,090	648,983	1.11	1,007,008	1,040,186	1.03	777,001	821,128	1.06
1998	23.25	2,768,242	3,152,441	1.14	469,674	513,911	1.09	889,192	1,040,886	1.18	966,859	1,108,274	1.15
1999	23.92	2,792,841	2,859,311	1.02	412,421	422,260	1.02	790,129	824,782	1.04	1,131,888	1,159,638	1.02
2000	22.15	2,784,282	3,506,969	1.26	360,142	442,690	1.23	625,008	784,771	1.26	1,369,081	1,758,993	1.28
2001	20.93	2,736,558	3,217,062	1.18	297,411	334,677	1.13	533,613	630,949	1.18	1,465,749	1,756,823	1.20
2002	16.89	2,798,748	3,842,129	1.37	277,431	388,052	1.40	451,492	605,786	1.34	1,568,089	2,176,695	1.39
2003	19.87	2,703,979	3,349,440	1.24	224,688	279,705	1.24	402,181	488,711	1.22	1,629,760	2,032,483	1.25
Average	22.98	2,722,440	3,288,111	1.21	646,928	834,952	1.25	942,193	1,101,074	1.18	821,507	985,117	1.13
Minimum	16.89	2,617,957	2,714,695	1.02	224,688	279,705	1.02	402,181	488,711	.99	125,420	119,489	.87
Maximum	29.25	2,798,748	4,213,952	1.53	1,255,529	2,036,707	1.62	1,351,933	1,830,417	1.44	1,629,760	2,176,695	1.39
Median	23.25	2,736,558	3,217,062	1.18	582,090	648,983	1.23	1,007,008	1,046,886	1.18	871,930	964,701	1.13
Slope	-.54	8,311	17,038	.001	-88,818	-115,553	-.018	-84,051	100,498	.007	161,420	207,285	.028
p-value	.080	.059	.760	.951	0	0	.200	.001	0	.583	0	0	.033

Table 12. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for all Groundwater Management Districts, Kansas, 1991–2003.—Continued

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Alfalfa			Corn			Grain sorghum			Soybeans			Wheat		
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)
1991	170,553	310,931	1.82	549,403	894,533	1.63	114,186	146,134	1.28	58,157	77,177	1.33	121,866	119,026	0.98
1992	156,936	223,463	1.42	605,668	682,696	1.13	111,150	86,009	.77	53,484	42,258	.79	118,010	103,199	.87
1993	153,921	198,053	1.29	688,231	768,144	1.12	60,315	39,611	.66	47,509	37,551	.79	102,871	69,599	.68
1994	160,389	266,508	1.66	715,510	1,044,370	1.46	53,262	50,113	.94	56,255	68,696	1.22	83,956	71,963	.86
1995	165,179	242,499	1.47	697,556	955,785	1.37	59,004	50,321	.85	52,216	55,170	1.06	85,703	57,835	.67
1996	157,808	209,153	1.33	836,376	1,021,810	1.22	55,866	40,040	.72	54,167	43,461	.80	62,576	42,927	.69
1997	174,131	243,692	1.40	899,556	1,039,558	1.16	46,486	32,729	.70	90,284	72,571	.80	70,123	46,433	.66
1998	186,439	290,103	1.56	930,388	1,193,245	1.28	27,873	19,923	.71	114,223	127,893	1.12	55,998	37,330	.67
1999	180,020	231,132	1.28	935,436	1,085,888	1.16	27,607	20,314	.74	136,151	136,248	1.00	65,230	36,112	.55
2000	163,139	271,837	1.67	973,269	1,382,066	1.42	23,342	19,732	.85	148,860	183,880	1.24	61,524	42,637	.69
2001	190,008	296,017	1.56	879,634	1,178,869	1.34	33,189	28,601	.86	151,505	193,889	1.28	81,909	52,927	.65
2002	214,420	372,587	1.74	846,089	1,316,444	1.56	38,944	38,317	.98	143,254	188,816	1.32	64,639	49,892	.77
2003	214,826	335,361	1.56	734,453	1,064,812	1.45	62,598	58,164	.93	127,090	166,273	1.31	94,586	63,725	.67
Average	175,982	268,564	1.52	791,659	1,048,325	1.33	54,909	48,462	.85	94,858	107,222	1.08	82,230	61,047	.72
Minimum	153,921	198,053	1.28	549,403	682,696	1.12	23,342	19,732	.66	47,509	37,551	.79	55,998	36,112	.55
Maximum	214,826	372,587	1.82	973,269	1,382,066	1.63	114,186	146,134	1.28	151,505	193,889	1.33	121,866	119,026	.98
Median	170,553	266,508	1.56	836,376	1,044,370	1.34	53,262	39,611	.85	90,284	77,177	1.12	81,909	52,927	.68
Slope	4,290	8,490	.012	30,535	40,121	.011	-4,474	-4,134	.01	9,913	13,699	.036	-3,800	-4,230	-.001
p-value	.003	.044	.502	.0087	.003	.360	.017	.059	.502	.004	.003	.044	.044	.044	.059

Table 12. Trends in precipitation and irrigation by system type, crop type, and prorated crop type for all Groundwater Management Districts, Kansas, 1991–2003.—Continued

Data from Kansas Water Office and Kansas Department of Agriculture (1993–2005). acre-ft, acre-feet; acre-ft/acre, acre-foot per acre. Blue shading indicates trend is significant at 95-percent level ($p \leq 0.05$). Green shading indicates trend is significant at 90-percent level ($p \leq 0.10$). NA, data not available]

Year	Other/multiple use			Total acres irrigated					
	Total acres irrigated	Irrigation water used (acre-ft)	Rate of irrigation (acre-ft/acre)	Prorated alfalfa	Prorated corn	Prorated grain sorghum	Prorated soybeans	Prorated wheat	Other prorated, unspecified
1991	1,734,241	2,666,151	1.54	186,354	1,061,028	389,972	58,157	601,890	86,445
1992	1,631,569	1,966,608	1.21	223,116	1,121,568	354,829	172,372	670,197	127,703
1993	1,565,110	1,601,733	1.02	217,597	1,252,824	226,134	155,547	654,467	109,140
1994	1,615,521	2,082,394	1.29	227,274	1,302,330	219,561	160,913	649,958	124,858
1995	1,596,146	1,907,393	1.19	234,234	1,272,904	212,908	151,655	638,298	145,157
1996	1,505,723	1,665,727	1.11	229,416	1,392,529	226,680	140,840	573,679	108,976
1997	1,470,091	1,474,061	1.00	246,452	1,460,226	180,249	184,286	586,722	91,637
1998	1,453,321	1,483,949	1.02	266,184	1,472,006	132,311	233,699	531,110	132,932
1999	1,448,397	1,349,617	.93	251,984	1,468,261	127,502	267,110	522,827	155,157
2000	1,414,148	1,606,815	1.14	228,385	1,501,225	107,393	294,190	512,553	140,539
2001	1,400,313	1,466,756	1.05	250,874	1,363,507	133,145	304,186	511,286	173,503
2002	1,491,402	1,876,072	1.26	288,799	1,349,382	174,813	283,782	530,380	171,593
2003	1,470,426	1,661,107	1.13	291,541	1,188,203	218,536	255,954	551,252	198,494
Average	1,522,801	1,754,491	1.14	241,708	1,323,538	208,003	204,822	579,586	135,856
Minimum	1,400,313	1,349,617	.93	186,354	1,061,028	107,393	58,157	511,286	86,445
Maximum	1,734,241	2,666,151	1.54	291,541	1,501,225	389,972	304,186	670,197	198,494
Median	1,491,402	1,661,107	1.13	234,234	1,349,382	212,908	184,286	573,679	132,932
Slope	-21,324	-45,891	-.013	6,764	26,548	-16,384	16,509	-11,117	6,944
p-value	.0012	.059	.2463	.001	.059	.0087	.0041	.002	.004

Table 13. Results of regression analysis for irrigation water use and irrigation application rates based on average annual county precipitation for 1991–2003.

[Shading indicates correlation coefficients (R) greater than or equal to 0.71, explaining greater than 50 percent of the variability. x equals average annual precipitation, in inches; --, not determined]

County (fig. 1)	Water-use equation	Water-use correlation coefficient (R)	Application rate equation	Application rate correlation coefficient (R)
Barton	$y = -1501x + 69062$	.81	$y = -0.0123x + 1.664$	0.12
Cheyenne	$y = -1339.7x + 73702$	.54	$y = -0.0282x + 1.7491$	.18
Edwards	$y = -3361.9x + 189271$	.83	$y = -0.0097x + 1.6119$	.08
Finney	$y = -9630.4x + 489486$	.68	$y = -0.0036x + 1.3451$	0
Ford	$y = -2836.8x + 155916$	.85	$y = -0.0032x + 1.402$	.01
Graham	$y = -535.24x + 21700$	.79	$y = -0.0154x + 1.6538$	.14
Grant	$y = -1648.3x + 194630$	.17	$y = 0.0246x + 0.9566$	.05
Gray	$y = -3824.1x + 315811$	.57	$y = -0.0077x + 1.4623$	.04
Greeley	$y = -1130.3x + 47359$	.43	$y = -0.0441x + 2.093$	.24
Harvey	$y = -460.87x + 40082$	.35	$y = -0.0067x + 1.6175$	.01
Haskell	$y = -3864.1x + 350668$	.33	$y = 0.0037x + 1.272$	0
Kearny	$y = -3208.9x + 199603$	.64	$y = -0.036x + 1.9801$	.24
Kiowa	$y = -1495.4x + 93668$	.70	$y = 0.0084x + 1.1972$	.05
Lane	$y = -363.8x + 25214$	.39	$y = -0.0121x + 1.5662$	.06
McPherson	$y = -913.32x + 52321$	.68	$y = -0.0082x + 1.6353$	.06
Meade	$y = -1620.7x + 205089$	.41	$y = 0.0412x + 0.6042$	.29
Morton	$y = -1174.2x + 76901$	.22	$y = -0.0007x + 1.406$	0
Pawnee	$y = -3251.9x + 141463$	.91	$y = -0.0034x + 1.439$	.02
Pratt	$y = -2161.9x + 138174$	.62	$y = -0.0056x + 1.5667$	.01
Rawlins	$y = -955.26x + 34492$	.85	$y = -0.0463x + 2.1954$	.44
Reno	$y = -56.154x + 39110$	.07	$y = 0.0026x + 1.3713$	0
Rice	$y = -907.33x + 42439$	.82	$y = 0.0006x + 1.3702$	0
Scott	$y = -1533.8x + 88164$	.40	$y = -0.0181x + 1.626$	.06
Sedgwick	$y = -688.53x + 54393$	.50	$y = -0.0018x + 1.4901$	0
Seward	$y = -2061.3x + 201174$	.36	$y = 0.0875x - 0.082$	.44
Sheridan	$y = -3264.9x + 141063$	.83	$y = -0.021x + 1.7417$	.26
Sherman	$y = -4164x + 192872$	.78	$y = -0.03x + 1.7905$	.32
Stafford	$y = -2371.9x + 141578$	.71	$y = -0.005x + 1.5$	.02
Stanton	$y = -3520.1x + 225817$	.30	$y = -0.0022x + 1.3796$	0
Stevens	$y = -2528.7x + 258922$	.40	$y = 0.0064x + 1.3172$	0
Thomas	$y = -5184.5x + 201931$	.86	$y = -0.0485x + 2.2238$	.51
Wallace	$y = -1584.5x + 99184$	.54	$y = -0.0331x + 1.8789$	.22
Wichita	$y = -3500.3x + 142917$	.66	$y = -0.001x + 1.3282$	0
Average for all counties	--	.58	--	.12

Table 14. Results of regression analysis for irrigation water use based on average annual precipitation by meteorological region for 1991–2003.

Groundwater Management District number (fig. 1)	Water-use equation	Meteorological region (fig. 1)	Percent variability explained (R^2) x 100
1	$y = -4,720x + 354,000$	x=Region 4 average annual precipitation	20
2	$y = -3,670x + 207,000$	x=Region 8 average annual precipitation	34
3	$y = -43,200x + 2,930,000$	x=Region 7 average annual precipitation	31
4	$y = -13,400x + 676,000$	x=Region 1 average annual precipitation	68
5	$y = -19,800x + 1,070,000$	x=Region 8 average annual precipitation	59
All	$y = -96,300 + 5,500,000$	x=Average of regions 1, 4, 7, and 8 precipitation	60

Table 15. Irrigation water use adjusted using average regional precipitation by meteorological region for Groundwater Management Districts within the Kansas High Plains, 1991–2003.

Year	Average precipitation for meteorological region 1, 4, 7, and 8 (fig. 1) (inches)	Total irrigation water use (acre-feet)	Regression-equation water use, equation 1 ¹ (acre-feet)	Precipitation-adjusted water use, equation 2 ² (acre-feet)
1991	20.86	4,213,952	3,492,000	3,824,000
1992	25.30	3,104,234	3,064,000	3,418,000
1993	29.25	2,714,695	2,683,000	3,455,000
1994	20.12	3,584,044	3,563,000	3,137,000
1995	23.64	3,269,003	3,223,000	3,363,000
1996	27.21	3,023,116	2,880,000	3,580,000
1997	25.39	2,909,044	3,055,000	3,214,000
1998	23.25	3,152,441	3,261,000	3,190,000
1999	23.92	2,859,311	3,196,000	2,976,000
2000	22.15	3,506,969	3,367,000	3,380,000
2001	20.93	3,217,062	3,484,000	2,930,000
2002	16.89	3,842,129	3,874,000	2,823,000
2003	19.87	3,349,440	3,586,000	2,896,000
Average	22.98	p=0.760 slope=+17,000	p=0.076 slope=+52,100	p=0.0003 slope=-77,700

¹Equation 1: Estimated water use = -96,300 x (average regional precipitation)+5,500,000.

²Equation 2: Estimated water use = Annual water use x (average regional precipitation/annual regional precipitation).

Table 16. Average precipitation plus irrigation-applied water for all Groundwater Management Districts within the Kansas High Plains, 1991–2003.

Year	Average precipitation for meteorological regions 1, 4, 7, and 8 (fig. 1) (inches)	All Groundwater Management Districts average irrigation application rate (acre-feet per acre)	All Groundwater Management Districts average irrigation application rate (inches)	Average precipitation plus irrigation application rate (inches)
1991	20.86	1.53	18.40	39.25
1992	25.30	1.16	13.92	39.22
1993	29.25	1.04	12.44	41.69
1994	20.12	1.33	16.02	36.13
1995	23.64	1.23	14.77	38.41
1996	27.21	1.13	13.57	40.78
1997	25.39	1.06	12.69	38.08
1998	23.25	1.14	13.67	36.92
1999	23.92	1.02	12.29	36.21
2000	22.15	1.26	15.11	37.26
2001	20.93	1.18	14.11	35.04
2002	16.89	1.37	16.47	33.36
2003	19.87	1.24	14.86	34.74

Table 17. Relation between irrigation system types and application rates, 1992–2003, for Groundwater Management Districts within the Kansas High Plains.

Groundwater Management District number (fig. 1)	Center pivot irrigation rate compared to drop nozzle irrigation rate	Percent variability explained, $R^2 \times 100$ (Y-intercept=0)	Flood irrigation rate compared to drop nozzle irrigation rate	Percent variability explained, $R^2 \times 100$ (Y-intercept=0)
1	$y = 1.048x$	74	$y = 0.9302x$	78
2	$y = 0.9834x$	70	$y = 0.8206$	82
3	$y = 0.9886x$	69	$y = 0.97x$	14
4	$y = 1.0004x$	96	$y = 0.8219x$	81
5	$y = 1.0007x$	90	$y = 1.1024x$	57
All Groundwater Management Districts	$y = 0.9793x$	83	$y = 0.9233x$	12
All counties in study area	$y = 0.9789$	62	$y = 0.8885x$	19

Table 18. Correlation coefficients for irrigation water-use factors for 33 counties in the Groundwater Management Districts within the Kansas High Plains, 1991–2003.

[Shading indicates correlation coefficients greater than or equal to 0.50. --, not applicable]

	Total water used for irrigation	Total acres irrigated	Alfalfa		Corn		Grain sorghum		Soybeans		Wheat		Other/multiple uses		Flood irrigation		Center pivot irrigation		Drop nozzle irrigation		Annual precipitation	March–October precipitation	County soil permeability
			Acres	Water application rate	Acres	Water application rate	Acres	Water application rate	Acres	Water application rate	Acres	Water application rate	Acres	Water application rate	Acres	Water application rate	Acres	Water application rate	Acres	Water application rate			
Total acre-feet of water	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total acres irrigated	.97	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Alfalfa acres	.61	.63	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Alfalfa water application rate	.55	.48	.33	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Corn acres	.58	.66	.44	.19	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Corn water application rate	.70	.58	.31	.70	.20	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Grain sorghum acres	.18	.21	.24	.10	.06	.05	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Grain sorghum water application rate	.33	.22	.14	.38	-.01	.55	.15	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Soybean acres	-.09	-.06	.12	-.26	.22	-.25	.01	-.03	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Soybean water application rate	.23	.21	.27	.10	.36	.19	.11	.10	.33	1	--	--	--	--	--	--	--	--	--	--	--	--	--
Wheat acres	.69	.72	.67	.37	.43	.39	.42	.17	-.07	.16	1	--	--	--	--	--	--	--	--	--	--	--	--
Wheat water application rate	.50	.41	.22	.48	.05	.62	.16	.43	-.24	-.03	.32	1	--	--	--	--	--	--	--	--	--	--	--
Other/multiple use acres	.91	.90	.39	.51	.34	.64	.13	.26	-.29	.03	.58	.49	1	--	--	--	--	--	--	--	--	--	--
Other/multiple use water application rate	.58	.42	.15	.58	.10	.86	.08	.62	-.07	.22	.23	.57	.49	1	--	--	--	--	--	--	--	--	--
Flood irrigation acres	.66	.61	.26	.32	.04	.47	.29	.30	-.29	-.05	.50	.49	.75	.43	1	--	--	--	--	--	--	--	--
Flood irrigation water application rate	.48	.35	.05	.45	.22	.75	.01	.46	-.13	.19	.21	.44	.37	.80	.25	1	--	--	--	--	--	--	--
Center pivot irrigation acres	.60	.65	.59	.26	.59	.25	.36	.13	.10	.13	.65	.18	.44	.21	.32	.18	1	--	--	--	--	--	--
Center pivot irrigation water application rate	.64	.51	.43	.68	.28	.84	.02	.54	-.06	.29	.33	.54	.47	.82	.34	.59	.31	1	--	--	--	--	--
Drop nozzle irrigation acres	.48	.53	.44	.27	.59	.27	-.12	-.01	.22	.34	.25	.07	.35	.11	-.14	.14	.01	.28	1	--	--	--	--
Drop nozzle irrigation water application rates	.30	.31	.28	.24	.33	.26	-.28	-.06	.07	.11	.09	.07	.23	.13	-.07	.10	.07	.32	.49	1	--	--	--
Annual precipitation	-.39	-.32	-.14	-.59	-.12	-.67	.05	-.37	.40	-.10	-.22	-.43	-.39	-.53	-.19	-.55	.05	-.56	-.33	-.28	1	--	--
March–October precipitation	-.37	-.29	-.12	-.58	-.08	-.64	.02	-.38	.37	-.11	-.21	-.42	-.36	-.54	-.21	-.54	.06	-.54	-.28	-.23	.97	1	--
County soil permeability	-.12	-.01	-.04	-.29	.04	-.39	.01	-.34	-.07	-.30	-.01	-.19	-.02	-.46	.01	-.42	.14	-.39	-.07	-.13	.20	.18	1

Table 19. Predictive equations for irrigation water use and irrigation application rates from county data for all Groundwater Management Districts within the Kansas High Plains, 1991–2003.

[TWU, irrigation water use, in acre-feet; TA, total acres irrigated; MOP, March–October precipitation by county, in inches; AP, annual precipitation by county, in inches; CR, water application rate for corn, in acre-feet per acre; AR, water application rate for alfalfa, in acre-feet per acre; WR, water application rate for wheat, in acre-feet per acre; OA, other/multiple-use acres; SP, soil permeability]

Predictor equation	Percent variability explained (R ²) x 100	Residual standard error ¹ (acre-feet)	Degree of freedom	F statistic ²
TWU = 1.3809(TA) - 14,866	94	19,990	427	6,573
TWU = -4,826(AP) + 210,202	16	74,410	427	78
TWU = -5,351(MOP) + 206,781	14	75,120	427	68.8
TWU = 1.3385(TA) - 1140(AP) + 14,811	95	18,700	426	3,788
TWU = 1.3402(TA) - 1,400(MOP) + 16,576	95	18,530	426	3,859
TWU = 184,305(CR) - 135,625	49	57,560	427	145
TWU = 17,310(AR) + 149,728(CR) + 26,504(WR) - 129,328	51	57,010	425	417
TWU = 1.7917(OA) + 16.698	82	34,090	427	1,980
CR = -0.0311(AP) + 1.999	43	.2304	427	339.6
CR = -0.0333(AP) + 0.0575(SP) + 1.9131	49	.2202	426	206.4
AR = -0.0253(AP) + 0.0641(SP) + 1.5530	45	.188	426	173

¹Residual standard error = standard deviation of difference between predicted value and actual value. Lower number defines a better model.

²F-statistic = a test to see if the model coefficients are statistically different from zero. A higher number defines a better model.