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WATER USE IN KANSAS, 1990–2000

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Abstract

This fact sheet compares water use in 1990, 1995, and 2000 for the 12 major river basins in Kansas. Of these 3 years, irrigation water use was largest in 1990 and smallest in 1995, largely because of differing climatic conditions. Irrigation averaged about 85 percent of total water use in Kansas each year, and ground water pumped in the western part of the State provided most of the irrigation water used. Water use for public supply, industry, and livestock increased between 1990 and 2000. Total State population increased 8 percent between 1990 and 2000, and the number of people served by public water suppliers increased 12 percent. Surface water withdrawn for public supply increased 24 percent because of population growth in the northeastern and south-central parts of the State and decreasing reliance on ground water by the city of Wichita. From 1990 to 2000, ground-water withdrawals for livestock and meat processing increased in western Kansas, and surface-water withdrawals for sand dredging increased in eastern Kansas. This fact sheet was produced as part of an ongoing cooperative program supported in part by the Kansas State Water Plan Fund.

Introduction

Information on water use in Kansas is important for water-rights administration, water-supply planning, conservation efforts, interstate water issues, and documenting trends in water use. By law, the Kansas Department of Agriculture–Division of Water Resources (DWR) administers water rights for all beneficial uses and requires annual water-use reports for all water rights except domestic. This information is used to establish and enforce water appropriations for beneficial uses, primarily irrigation, public supply, and industry. The Kansas Water Office (KWO) uses the data for water-supply planning, water marketing, and population projections. The U.S. Geological Survey (USGS) assists these State agencies with water-use data collection, evaluation, database maintenance, and publication of annual summaries of irrigation and public-supply water use. At 5-year intervals, the USGS provides water-use data for the national report, “Estimated Use of Water in the United States” (see Hutson and others, 2004; Solley and others, 1993, 1998).

Most of the water-use data in this fact sheet were derived from site-specific information reported to DWR by irrigators, public water suppliers, and industries. Data are aggregated by the 12 major river basins in Kansas, as previously shown for 1990 and

1995 (Kenny, 1999). These basins (fig. 1) are the planning units used by the Kansas Water Office in administering the State Water Plan Fund. Population distribution, water availability, and predominant water uses vary considerably among these basins. The Upper Republican, Solomon, Smoky Hill–Saline, Upper Arkansas, Cimarron, and Lower Arkansas Basins cover the western two-thirds of the State and are identified hereafter as “western” basins. Most of the available ground water and irrigated agriculture are located in these basins. The Walnut, Verdigris, Neosho, Marais des Cygnes, Kansas–Lower Republican, and Missouri River Basins cover the eastern one-third of the State and are designated hereafter as “eastern” basins. Most of the available surface water and large population centers, with the exception of Wichita, are located in these basins.

Average annual precipitation increases from west to east in Kansas and ranged from less than 20 inches in southwestern Kansas to more than 40 inches in southeastern Kansas during 1990, 1995, and 2000. Of these 3 years, total annual precipitation for the State was smallest during 2000 and largest during 1995 (National Oceanic and Atmospheric Administration, 1990–2000).

Total Water Use

The major categories of water use in Kansas are irrigation, public supply, industrial, and livestock. For this fact sheet, mining and thermoelectric power generation water uses were included in the industrial category, and aquaculture was included in the livestock category. A small but important category of use, self-supplied domestic use, also is shown.

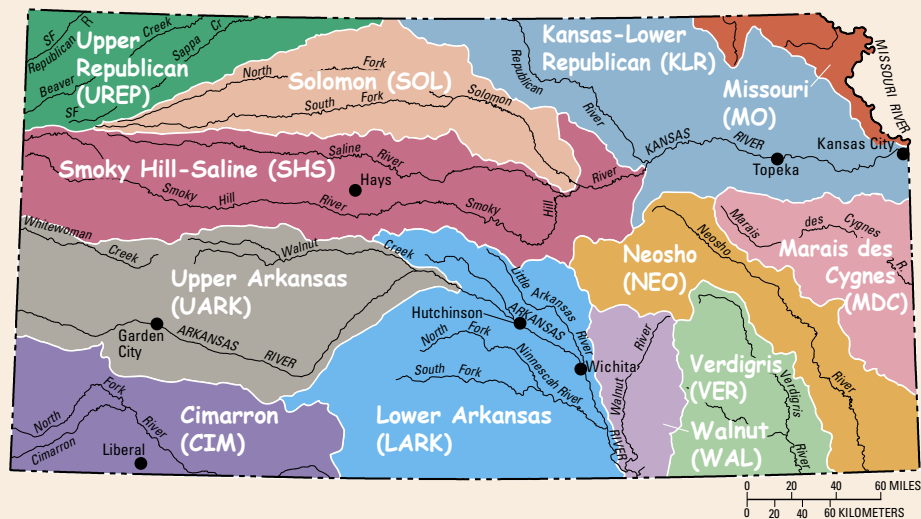


Figure 1. Major river basins in

Water use totaled 4,430 million gallons per day (Mgal/d) in 2000 (fig. 2). About 84 percent of the freshwater withdrawn in Kansas during 2000 was used for irrigation. The second largest use of water in 2000 was public supply, which comprised about 9 percent of the total. Self-supplied industrial uses represented less than 4 percent of the 2000 total, and livestock uses represented less than 3 percent. Self-supplied domestic use represented 0.5 percent of the 2000 total.

Water use for irrigation in 2000 was about 10 percent larger than in 1995 and about 11 percent smaller than in 1990, primarily because of different climatic conditions. Water use for public supply, industrial uses, and livestock were larger in 2000 than in 1990. Estimated water withdrawn for self-supplied domestic use decreased slightly from 1990 to 2000 because increasing numbers of people obtained their household water from public suppliers.

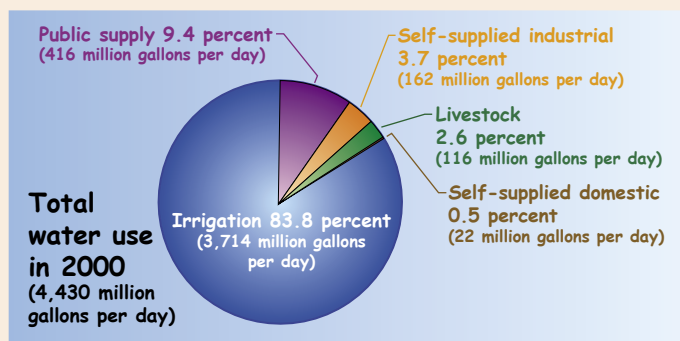


Figure 2. Major categories of water use in Kansas, 2000.

Irrigation Water Use

Irrigation is the largest use of water in Kansas. Irrigation withdrawals were 3,714 Mgal/d (4.16 million acre-feet per year) in 2000, 3,383 Mgal/d (3.79 million acre-feet per year) in 1995, and 4,186 Mgal/d (4.69 million acre-feet per year) in 1990. About 75 percent of the State's irrigation water use occurred in the Upper Arkansas, Cimarron, and Lower Arkansas River Basins (fig. 3). More than 92 percent of all irrigation withdrawals for each of the 3 years in Kansas was from ground water. About 33 percent of all ground water used for irrigation in 2000 was pumped in the Upper Arkansas River Basin.

Only the Kansas–Lower Republican, Solomon, and Upper Arkansas River Basins use significant amounts of surface water for irrigation. Surface-water irrigation use was supplied primarily by irrigation districts that deliver water through canals from reservoirs in the north-central part of the State (Kansas–Lower Republican and Solomon River Basins) and from the Arkansas River in western Kansas (Upper Arkansas River Basin). In the Solomon and Upper Arkansas River Basins, more surface water was used for irrigation in 1995 and 2000 than in 1990 because of greater availability of water to supply the irrigation canals.

Irrigation water use varies from year to year primarily because of climatic differences, but the quantity of water used also is affected by changes in water availability, efficiencies of various application methods, and the types and acreages of crops grown. Of the 3 years presented in this report, total irrigation water use was largest in 1990 when precipitation was less than normal and summer temperatures were above normal throughout most of the State. Irrigation water use was least among the 3 years during 1995, when temperatures and precipi-

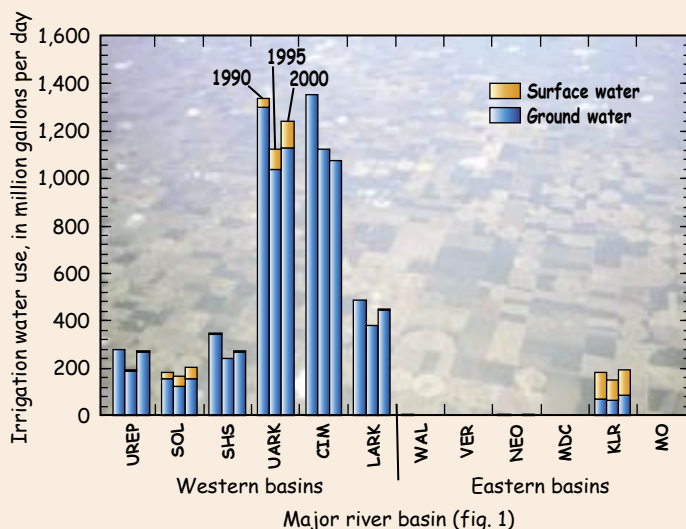


Figure 3. Irrigation water use in 1990, 1995, and 2000 by river basin.

tation were close to normal. The warmest and driest conditions prevailed in 2000, but irrigation water use was 11 percent less that year compared to 1990. The largest decrease in irrigation water use occurred in the Cimarron River Basin, where withdrawals were 21 percent less in 2000 than in 1990 as a result of declining ground-water levels and conversion of irrigation systems from flood to sprinkler.

Of the 3 years described in this report, more acres (3.31 million) were irrigated in 2000, 7 percent more than either 1990 or 1995. The average irrigation application rate for the State in 2000 was 1.26 acre-feet per acre, compared to 1.51 acre-feet per acre in 1990 and 1.23 acre-feet per acre in 1995.

Population and Public-Supply and Self-Supplied Domestic Water Use

Total Kansas population increased from nearly 2.5 million people in 1990 to nearly 2.7 million people in 2000, according to the U.S. Bureau of Census (2002). Nearly 40 percent of the population in 2000 lived in the Kansas–Lower Republican River Basin, and nearly 25 percent lived in the Lower Arkansas River Basin. Nearly 75 percent of the population growth from

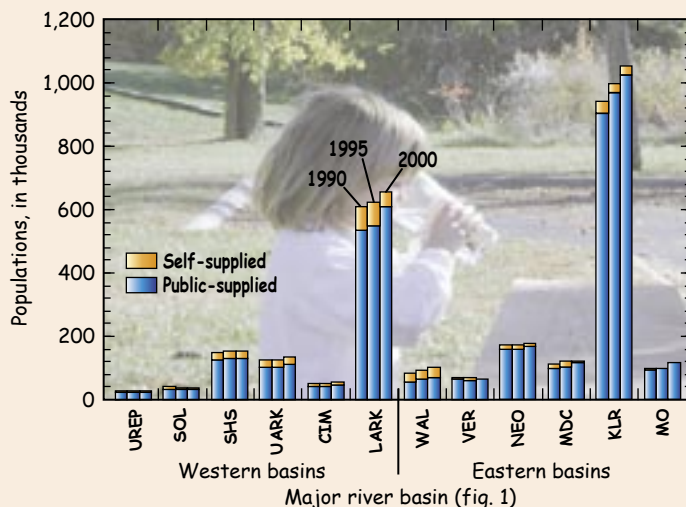


Figure 4. Self-supplied domestic and public-supplied populations in 1990, 1995, and 2000 by river basin.

1990 to 2000 occurred in these two basins. Population declines occurred in the Solomon, Upper Republican, and Verdigris River Basins from 1990 to 2000.

Numbers of people served by cities, rural water districts, and other public suppliers are reported to DWR on annual water-use reports. The population served also may be estimated using numbers of active residential service connections and population data from the U.S. Bureau of Census. Self-supplied populations in each county were calculated as the difference between total census populations and population served by public suppliers.

More than 90 percent of the population in Kansas obtained drinking water from public suppliers in 1990, 1995, and 2000; the remainder was self supplied (fig. 4). The population served by public water suppliers increased by 12 percent between 1990 and 2000. An estimated 192,900 Kansans obtained drinking water from private wells in 2000, a decrease of 56,900 people compared to 1990. The percentage of Kansans that were self supplied decreased from 10 percent in 1990 to 7 percent in 2000.

Public water suppliers include cities, rural water districts, housing developments, and mobile home parks. Water provided by public suppliers is used for domestic, commercial, industrial, and public uses. The amount of water used for public supply in Kansas increased by 11 percent between 1990 and 2000. About 416 Mgal/d were used for public water supply in Kansas in 2000 compared to 373 Mgal/d in 1990 and 370 Mgal/d in 1995. Surface water is the predominant source of public supply in the six eastern basins because of the availability of water from streams and large reservoirs. Ground water is the predominant source of public supply in the six western basins (fig. 5).

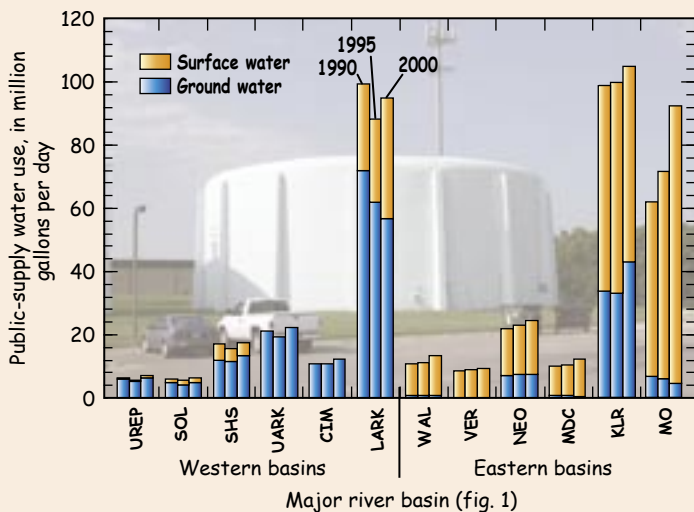


Figure 5. Public-supply water use in 1990, 1995, and 2000 by river basin.

Surface water provided 59 percent of the public-supply water use in 2000 and 53 percent in 1990. The percentage of public-supply water obtained from rivers and reservoirs increased in the Lower Arkansas and Missouri River Basins between 1990 and 2000. The largest increases occurred in the Missouri River Basin, where surface water is withdrawn from the Missouri River and used in suburban areas near Kansas City (Kansas–Lower Republican Basin). Surface-water withdrawals in the Missouri River Basin increased 58 percent from 1990 to 2000, from 55.4 to 87.6 Mgal/d. Ground-water withdrawals for

public supply in the Lower Arkansas Basin declined by 21 percent from 1990 to 2000, from 71.9 to 56.8 Mgal/d, largely because the city of Wichita relied increasingly on surface water during that time period. As part of efforts to slow water-level declines in its well field in the Equus Beds aquifer, Wichita has increased its use of water from Cheney Reservoir when available. Public-supply use was less in 1995 than in 1990 and 2000 in several basins, including the Lower Arkansas, because of moderate climatic conditions and less demand for water.

Self-supplied domestic water use is that used for indoor and outdoor purposes at homes not served by public water suppliers. Self-supplied domestic water use was estimated using the self-supplied populations and per-capita averages developed using customer sales data from small water systems throughout Kansas. Self-supplied domestic use was estimated to be nearly 25 Mgal/d in 1990, 24 Mgal/d in 1995, and 22 Mgal/d in 2000. All self-supplied domestic use in Kansas was assumed to be from ground water. Self-supplied domestic per-capita water use for 2000 ranged from 56 gallons per day in the Neosho River Basin to 300 gallons per day in the Cimarron, Upper Arkansas, and Upper Republican Basins, and averaged 112 gallons per day statewide.

Self-Supplied Industrial Water Use

Industrial water rights in Kansas are issued for three main categories—industrial, mining, and thermoelectric power generation. Industrial uses of water in Kansas include production of salt, fertilizer, chemicals, and food, as well as manufacturing and petroleum refining. Mining uses include production of sand, gravel, stone, oil, gas, and coal. Thermoelectric uses include cooling at fossil fuel and nuclear powerplants.

Self-supplied industrial water uses for the three industrial categories totaled 162 Mgal/d in 2000 and 152 Mgal/d in 1995 and 1990. About 75 percent of the ground-water use for these categories occurred in the western basins, and nearly all of the surface-water use occurred in the eastern basins (fig. 6).

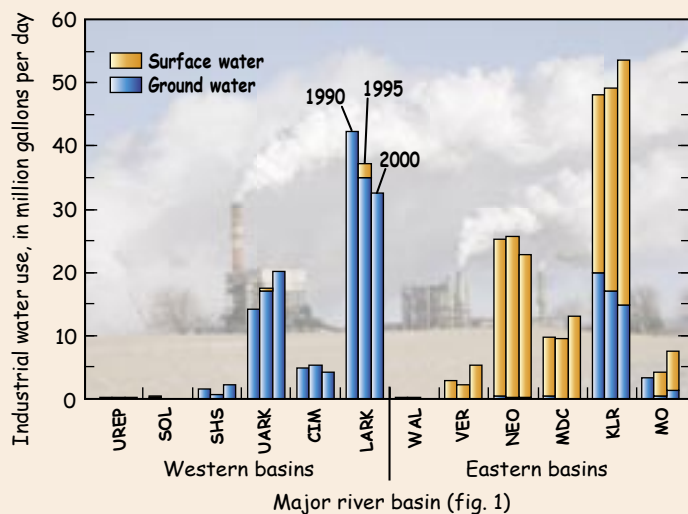


Figure 6. Self-supplied industrial water use in 1990, 1995, and 2000 by river basin.

Water use for the industrial category in Kansas was about 53 Mgal/d for each of the 3 years reported in this fact sheet. About 90 percent of this industrial use was from ground water. The largest industrial water use in Kansas was for meat processing, and most of these facilities were located in the Upper

Arkansas and Cimarron River Basins. Water use for meat processing increased in these basins by more than 50 percent between 1990 and 2000. Industrial ground-water use in the Lower Arkansas River Basin was mostly for salt production, petroleum refining, and manufacture of chemicals, fertilizers, paper, and plastics. Water use for these industries decreased between 1990 and 2000. Self-supplied ground-water use in the Kansas–Lower Republican River Basin was primarily for production of chemicals and cellophane; this use also decreased between 1990 and 2000. Industrial uses of surface water in the Neosho River Basin were primarily for cement production. In the Verdigris River Basin, industrial uses of surface water were primarily for petroleum refining.

Mining water uses in Kansas primarily consist of sand dredging and oil and gas production. Mining water use was about 26 Mgal/d in 1990, 24 Mgal/d in 1995, and 31 Mgal/d in 2000. Most of the ground-water use for sand dredging was in the Kansas–Lower Republican and Lower Arkansas River Basins, and most of the ground-water use for oil and gas industries was in the Cimarron and Lower Arkansas River Basins. Most of the surface-water use for sand dredging occurred in the Kansas–Lower Republican and Missouri River Basins. Increasing amounts of surface water were reported for sand dredging in the Kansas–Lower Republican and Missouri River Basins between 1990 and 2000 as a result of new water-rights requirements for dredging operations.

Water use for thermoelectric power generation reported to DWR represents water needed for cooling at powerplants and evaporation at cooling lakes. It does not include water that is returned to the environment after being nonconsumptively used. Water use for thermoelectric power generation ranged from 73 Mgal/d in 1990 to nearly 77 Mgal/d in 2000. About 80 percent was from surface water. The largest uses of surface water for thermoelectric power generation were in the Kansas–Lower Republican, Neosho, and Marais des Cygnes River Basins. Most of the ground-water use for thermoelectric power generation was in the Lower Arkansas and Upper Arkansas River Basins.

Livestock Water Use

Livestock water-use estimates in this report include usage at large facilities as well as small farms. Facilities of 1,000 head or more are required to report annual water use to DWR. Addi-

tional livestock water use was estimated using annual statistics on animal numbers (Kansas Department of Agriculture and U.S. Department of Agriculture, 1991, 1996, 2001) along with DWR water-use coefficients in gallons per head per day. A small amount of reported water use for operating fish farms (aquaculture) is included in this category.

Livestock water use occurred in every basin in Kansas (fig. 7) and ranged from 107 Mgal/d in 1990 to 116 Mgal/d in 2000. About 90 percent of the water used in this category was for beef cattle, both in feedlots and on pasture. Smaller amounts of water were used for dairy cattle, hogs, and poultry. Ground water provided most of the livestock use in western Kansas. Farm ponds and wells were common sources of water for livestock in eastern Kansas.

Between 1990 and 2000, livestock water use increased by 39 percent in the Upper Arkansas River Basin, from 17.6 to 24.5 Mgal/d. In the Cimarron River Basin, livestock water use increased by 61 percent, from 10.1 Mgal/d in 1990 to 16.3 Mgal/d in 2000. These two basins represented 35 percent of all livestock water use in Kansas in 2000. Livestock water use decreased between 1990 and 2000 in the Lower Arkansas, Kansas–Lower Republican, and Missouri River Basins.

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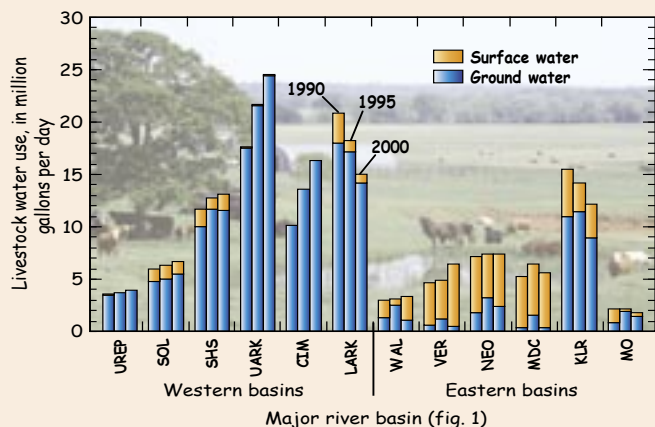


Figure 7. Livestock water use in 1990, 1995, and 2000 by river basin.

For more information on water use, visit the following Web sites:

<http://ks.water.usgs.gov/Kansas/studies/wateruse/>
<http://water.usgs.gov/watuse/>
<http://www.ksda.gov/Default.aspx?tabid=173>
<http://www.kwo.org/>

or contact:
 District Chief
 U.S. Geological Survey
 4821 Quail Crest Place
 Lawrence, Kansas 66049–3839
 (785) 841–9909
 E-mail: dc_ks@usgs.gov