

Unit 3) Cropland

Kansas has more available cropland, about 30 million acres, than any other state except Texas. All together, the cropland acres in Kansas would cover approximately 46,159 square miles, an area larger than 28 other individual states, including such states as Pennsylvania, Ohio, Virginia, and Tennessee. In Kansas, around 23 million acres of cropland are planted each year. The major Kansas crops include wheat, corn, soybeans, grain sorghum, alfalfa, cotton, and sunflowers. Other field crops include potatoes, pinto beans, oats, barley, and canola.

It was not always this way. In 1806, Lt. Zebulon Pike thought the prairie grasslands were not capable of growing crops. Major Stephen H. Long verified Pike's observations a few years later, considering this part of the country uninhabitable by people dependent on agriculture for their subsistence. This area was labeled the "Great American Desert" and for many years, most people thought it would not be a suitable place to live, let alone someday worthy of the title "Breadbasket of the World."

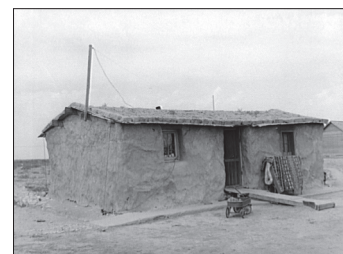
Today, nearly 90 percent of the land in Kansas is devoted to agriculture. This includes cropland (land available for the cultivation of plants or agricultural produce, such as grain, vegetables, or fruit), land used for livestock production (pasture, rangeland, and grassland), and land producing forestry and other related products (forests, orchards, and Christmas tree farms).

"Reasonable people adapt themselves to the world. Unreasonable people attempt to adapt the world to themselves. All progress, therefore, depends on unreasonable people."

George Bernard Shaw, Irish-British playwright

In 1803, Kansas joined the United States as part of the Louisiana Purchase. However, early pioneers generally settled along the eastern border of the state until the Homestead Act of 1862 opened the Kansas Territory for land ownership. During the next few decades, Kansas experienced a population explosion such as in the twenty years from 1870 to 1890 when the population of Kansas nearly quadrupled, from 364,000 to over 1.4 million. People claimed land for farms and ranches. Other new arrivals built towns and railroads.

Railroads and town development companies even paid people to go to eastern states and foreign countries to recruit people to come to Kansas. Wealthy families in the eastern states and European countries invested in land in Kansas, expecting large profits on those investments.



Sod House, Sheridan County, 1939

Source: Library of Congress;
Russell Lee, photographer

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Cropland



Log Barn, Cherokee County, 1936

Source: Library of Congress; Arthur Rothstein, photographer

Pioneering homesteaders, however, found that it was incredibly hard work to create new farms, homes, and communities in the vast grasslands of Kansas. The hard work, natural disasters, and other factors convinced many to abandon their efforts. Others persevered and laid the foundation for Kansas as we know it in the twenty-first century.

Land that can produce a crop for harvest is called cropland. Today, over 56 percent of the land in Kansas is

considered cropland according to the Kansas Agricultural Statistics Service. Only a portion of that cropland is used for crops in any given year. Some of the cropland is left idle (unplanted). Cover crops and soil improvement crops, planted to prevent erosion or to add organic matter or nitrogen to the soil, are also planted on "idle" cropland. More than 10 percent of the cropland in Kansas, over three million acres, has been enrolled in the Conservation Reserve Program (CRP) for ten or more years. Cropland enrolled in the CRP is usually planted to grasses and forbs but some of the marginal cropland has been planted to trees.

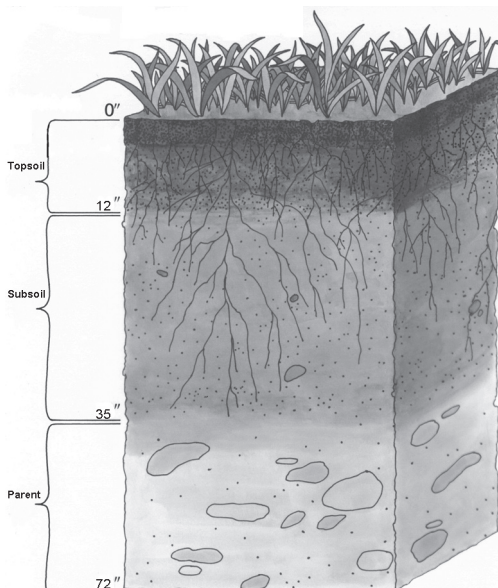
SOILS

"Out of a long list of nature's gifts to man, none is perhaps so utterly essential to human life as soil."

Hugh Bennett, first chief, Soil Conservation Service

The rich, productive soil of Kansas is the state's most valuable natural resource. Soil is the naturally occurring mixture of minerals, organic matter, water, and air that forms on the surface of the earth. Some soils were formed by the breaking down and weathering of rock. Others were formed from materials transported and deposited by water, wind or glaciers. It takes 100 to 600 years or more to form an inch of topsoil, the most productive soil layer.

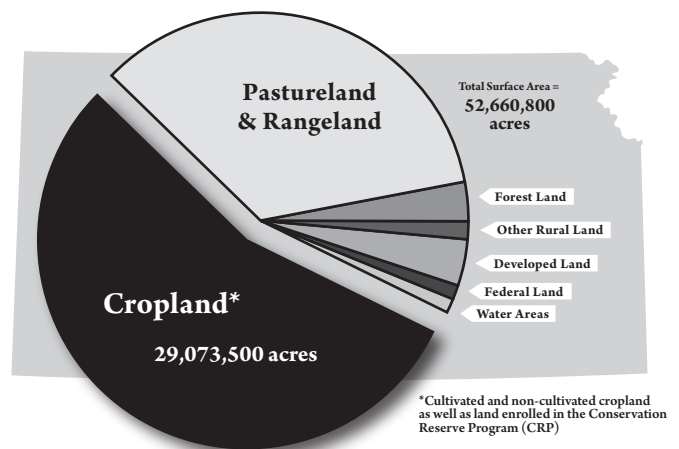
A soil is usually made up of four layers, called horizons. The layer at the earth's surface is the topsoil. Going down, the other three



Soil Profile

Source: USDA NRCS

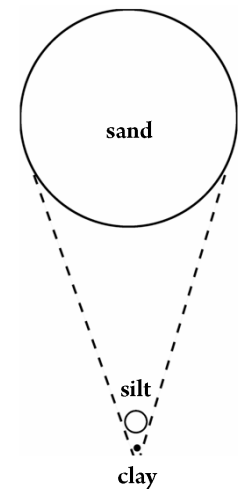
SURFACE AREA OF KANSAS – CROPLAND



Source: 2003 Natural Resources Inventory, USDA NRCS

layers are the subsoil, parent material, and bedrock. The thickness and qualities of each layer will vary depending on location. The mineral particles that make up the soil are clay, silt, and sand. The largest and most abundant of the three sizes of particles are sand particles. Silt particles feel like powder. Clay particles are so small that they can only be seen through electron microscopes. Soil textures are determined by the percentages of sand, silt, and clay in the soil mixture. Clay soils are fine and sticky while silty soils are smooth but crumble when wet. Sandy soils are gritty and abrasive whether wet or dry. Loam soils contain equal amounts of sand, silt, and clay. Color is an indicator of soil properties and is used to identify different soil layers. Generally, the color of a soil becomes darker as the amount of organic matter in the soil increases. Organic matter is plant and animal material in various stages of decomposition.

Particle Size



Unlike sand particles, individual silt and clay particles cannot be seen unless they are magnified.

Source: KFAC

The National Cooperative Soil Survey program has been mapping the soils of the United States for over 100 years. They have established a system of identification that divides all the soils in the United States into 12 soil orders. Each of the soil orders is then subdivided several times, resulting in about 18,000 different soil types. Every soil type has distinct properties. The soil type never changes but the health (productivity) of the soil can be influenced by the way the soil is managed.

KANSAS SOILS

Over 300 different soil types have been identified and mapped in the state of Kansas. The dominant soil order of the Kansas croplands is the mollisols. Mollisols are naturally fertile and can hold large amounts of water. They have a very distinct dark color and are

SOIL SURVEYS

Every county in Kansas has a soil survey, compiled by the U.S. Department of Agriculture Natural Resources Conservation Service in cooperation with the Kansas Agricultural Experiment Station. Originally published as a book of maps, the information is now available online (<http://websoilsurvey.nrcs.usda.gov>). The online database includes location-specific soils data, including information on soil suitability for various uses.

Originally, the soil surveys were published to provide information in planning land uses, including predictions of soil limitations and the impacts of selected land uses on the environment.

enriched with organic matter. These soils are capable of producing abundant agricultural crops.

The soils of Kansas evolved under the great prairie grasslands. Kansas has more acres of prairie soils than any other state and Kansas soils are internationally recognized.

Every state has an official state soil. In 1990, Harney silt loam was adopted as the Kansas State Soil. Harney silt loam possesses all the desirable qualities of an ideal prairie soil. It is the most widespread soil type in Kansas, covering almost four million acres in 26 counties.

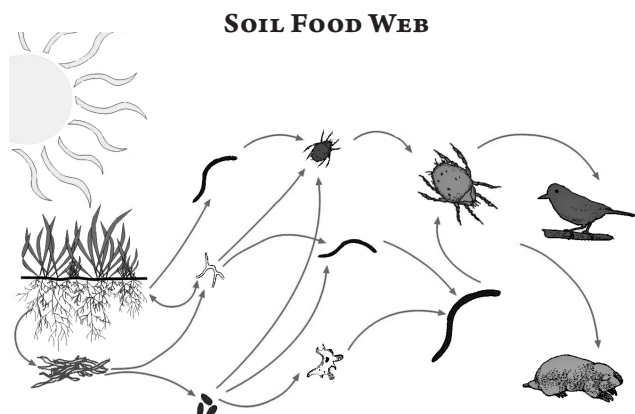
SOIL FOOD WEB

When we think of what lives in the soil, one of the first things we typically think of is the plants that grow in the soil. During photosynthesis, plants use water, the sun's energy, and carbon dioxide from the atmosphere to make the food necessary for the plants to grow and develop. Organisms living in the soil feed on carbon stored in the soil by plant roots and other decaying organic

materials. The soil food web builds as some organisms specialize in decomposing materials and predators at higher and higher levels in the food chain feed on the incredible diversity of organisms present in the soil. According to the National Soil Survey Center of the USDA Natural Resources Conservation Service, a single spade full of rich soil can contain more species of organisms than can be found above ground in the entire Amazon rain forest! Each time an organism is consumed or something decomposes, nutrients are converted into a different form and become available to plants and other organisms. All plants depend on the soil food web for nutrients. Increasing the organic matter of the soil also increases the ability of the soil to produce crops.

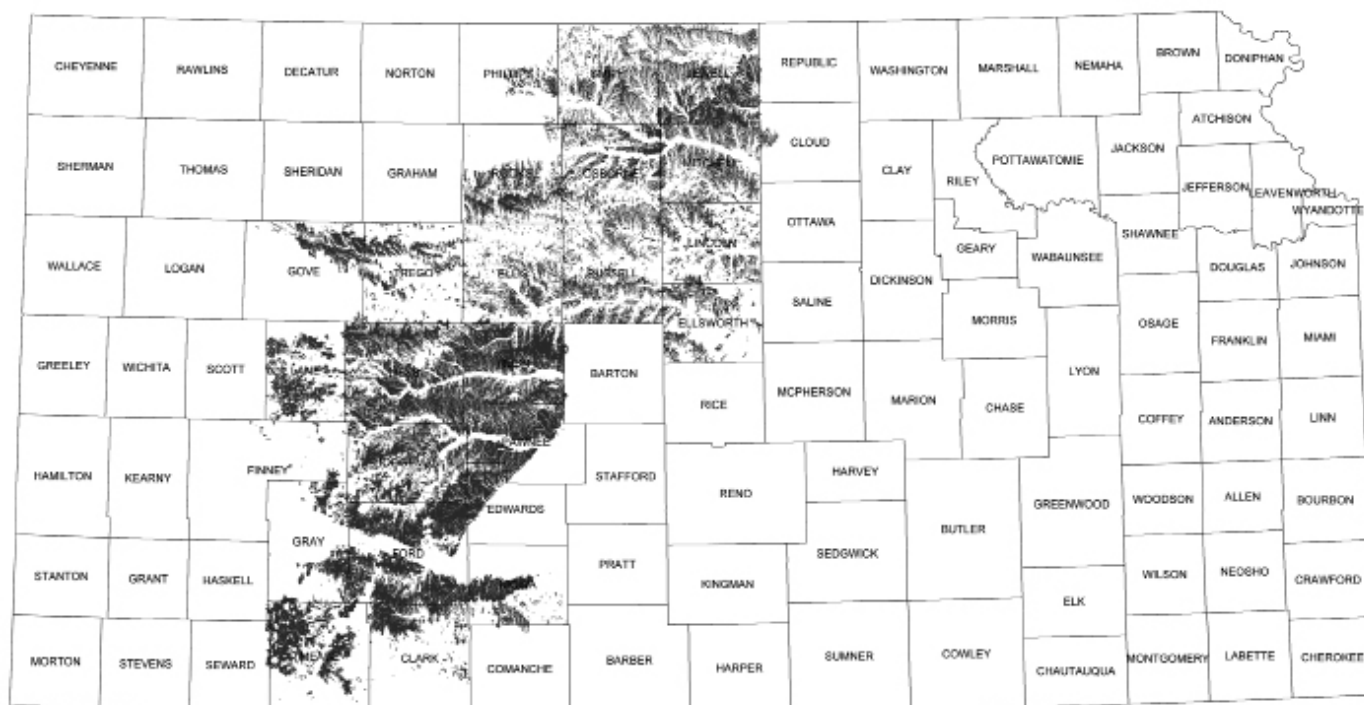
The soil food web is critical to the four major soil functions:

- Providing a physical, chemical, and biological environment for the exchange of water, nutrients, energy, and air needed to support the growth of plants and animals.



Source: USDA NRCS

HARNEY SILT LOAM IN KANSAS



Source: USDA NRCS

Cropland

- Protecting the quality of water, air, and other resources by filtering, buffering, degrading and detoxifying potential pollutants.
- Regulating the distribution and storage of water and other nutrients and compounds dissolved in the water.
- Storing, controlling the release of, and cycling plant nutrients and other elements.

PLANT NUTRIENTS

Since 1940, crop production has increased dramatically after remaining fairly constant during the decades following the Civil War. Today, most crops have the potential to produce three to five times the average yield per acre of 1940. Scientific research and technological advances in genetics, seed production, fertilizers, equipment, pesticides, and herbicides have helped farmers achieve these results. Farmers also manage soil nutrients, adding nutrients to the soil to meet the needs of specific crops while minimizing the loss of unused soil nutrients through erosion and evaporation. There are at least 16 nutrients essential for a plant to complete its life cycle. These include nutrients obtained from water and air, such as hydrogen, oxygen, and carbon, as well as nutrients obtained from the soil. Nitrogen, phosphorus, and potassium (in that order) are the three nutrients most critical for plant growth and development.

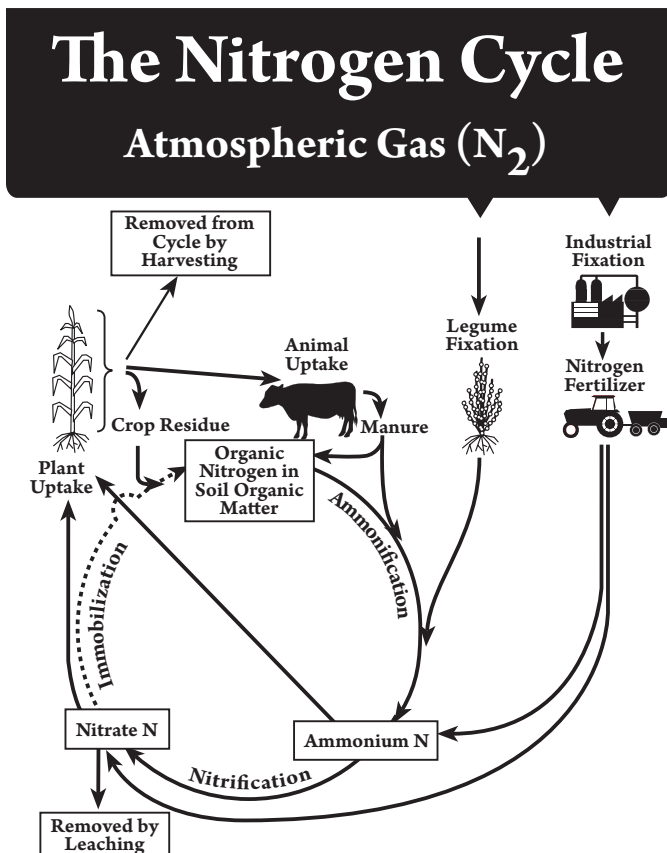
Plants use **nitrogen** to make proteins, used by plants to grow, develop, and produce seeds. Although 80 percent of the air that we breathe is nitrogen, plants cannot use the same form of nitrogen that we breathe. Some plants, called legumes, can collect nitrogen from the atmosphere and convert it into a form of nitrogen plants can use. Legumes also store excess useable nitrogen in the soil for future crops. Organic matter in the soil, through the soil food web,

creates and stores nitrogen in the soil. Commercial fertilizers and livestock manure are additional sources of nitrogen that can be used to increase plant production. Inadequate nitrogen is a common factor limiting a crop's ability to grow and produce. Nitrogen is the most expensive nutrient for the farmer to provide.

Phosphorus, also referred to as phosphate, helps plants use the sun's energy for photosynthesis, grow healthy roots and fight disease. All plants require more phosphorus during periods of rapid growth and phosphorus is essential for seed production. Phosphorus is taken up from the soil by the root system of the plant. However, if the phosphorus found naturally in the soil is in a form that the plant cannot use, phosphorus (in a form that the plant can use) must be added to the soil. Phosphorus is found in deposits of phosphate rock that are mined to manufacture phosphate fertilizers.

All plants require **potassium**, but annual crops and crops high in carbohydrates, such as potatoes, require high amounts of potassium, commonly referred to as potash. In addition to helping plants resist disease and tolerate drought and extreme temperatures, potassium assists different plants in different ways. In some plants, it strengthens the stalks. It increases the oil content of oilseeds. Potassium enhances the size and color of some fruits and vegetables.

Potassium is the seventh-most abundant element in the Earth's crust but only 2 percent is available to plants, generally in a form that is water soluble—able to move with the water in the soil and be taken up through the root system of plants. Potash is mined from underground deposits formed when ancient seas and oceans evaporated. Some potash is produced from the Great Salt Lake in Utah but most of the potash used in the United States is imported from Canada.



Source: K-State Research and Extension

SOIL TESTS

Soil tests are used to determine when it is necessary to add nutrients to the soil to sustain or increase crop production. Soil samples are collected and sent to laboratories for chemical analysis. Farmers use the results to manage crop production. Soil tests generally include testing for nitrogen, phosphorus, potassium, soil pH, and organic matter.

Soil pH is a measure of soil acidity or alkalinity, a measurement of the way the electrical charges on the surface of soil particles interact with chemical combinations in the soil mixture. Soil pH affects the rate at which plants absorb water, directly affecting the growth and development of plants. A neutral soil pH is 7.0 but most crops will grow well at soil pH levels of 6.0 to 7.5. When necessary, amendments are added to the soil, generally by spreading the material over the surface of the soil and then incorporating it into the soil mixture using tillage.

SOIL pH

Acidic	< 7.0
Neutral	7.0
Alkaline	> 7.0
Alkali	> 8.5 with high levels of sodium

Soil acidity is a natural soil process that develops over time as soil nutrients, mainly calcium, magnesium, and sulfur, are removed through high humidity and rainfall, plant growth, and soil uses. Acidic soils, those with a pH of less than 7.0, may be treated with finely ground limestone (lime). The active agent in limestone, calcium carbonate, creates a chemical reaction on the surface of the soil particles and neutralizes the acidity (pH) of the soil. The calcium then becomes part of the soil's nutrients that can be utilized by plants. Most limestone also contains magnesium carbonate, replenishing the soil's supply of magnesium for plants through a similar process. Adding lime to the soil increases the ability of many compounds in the soil to be absorbed in a form that plants can easily use as well as increases the activity of microorganisms in the soil. Soils with a pH of above 7.0



Horse-Drawn Lime Spreader, 1936

Source: Library of Congress; Arthur Rothstein, photographer



Lime Application, 2007

Credit: Trent Winter

are alkaline. Many soils in the western half of Kansas have a pH in the 7.5 to 8.5 range. Most crops will grow well on those soils unless the high pH is caused by excessive sodium. Alkali soils, those with a pH above 7.5 associated with high levels of sodium, may become toxic to all but salt-tolerant plants. Water and air movement may be restricted in high alkali soils and tillage does not help those problems. Although gypsum and sulfur may be used to lower soil pH levels using methods similar to those used to add lime to soils at the other end of the soil pH scale, it is not always practical or cost-effective.

Cost is just one factor that must be considered before taking any action to address soil pH levels. Many of the crop protection products that farmers use are also pH sensitive, requiring applicators to know the pH levels of the water used to mix the products for application procedures, soil pH levels, crop nutrient requirements, and other requirements specific to each location and crop.

WATER

"Rained a little last night. Enough to lay the dust. Corn nearly all dried up. For the life of me I don't see how the farmers will winter. No oats, no corn, no fruit, no grass, no nothing..."

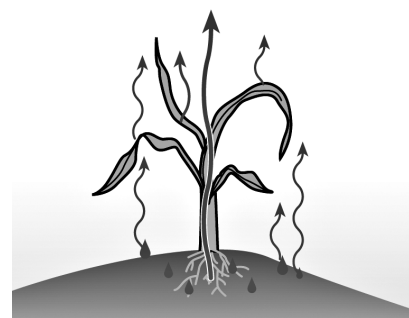
Diary of a Kansas farmer, July of 1887¹

Just as water is an absolute necessity to sustain human life, it is also essential to growing plants. In fact, some plants contain more water than solid matter, such as the alfalfa plant that is almost 80 percent water.

TRANSPIRATION

Through a chain reaction-type process called transpiration, water is pulled from the soil into the roots of a plant, up through the cells of the plant, and eventually out into the atmosphere through tiny openings in the plant's leaves. During the process, the water carries essential nutrients to the cells of the plant, so any interruption of the flow of water interrupts the plant's growth and development and the production of dry matter, such as flowers, seeds (grain), leaves,

EVAPOTRANSPIRATION



- **Evapotranspiration is the combination of evaporation and transpiration**
- **Evaporation is water movement from wet soil and leaf surfaces**
- **Transpiration is water movement through the plant**

Source: K-State Research and Extension

or stalks. Heat, sunlight, humidity, and wind affect the rate of transpiration, which is generally highest during the middle of the day and lowest at night. Transpiration continues only as long as there is an adequate supply of moisture in the soil. Once the water runs out, the plant begins to wilt. Even if the plant does not die, it may be damaged to the point where it can no longer produce a seed or forage crop. As much as 98 percent of the water absorbed by the roots of a plant may be released into the atmosphere through transpiration. In a Kansas cornfield, one acre of corn plants might transpire an amount of water during the May–September growing season that would cover the same area of land with water 11 inches deep.²

The production of a crop is determined by the timing and amounts of water provided to the plants during critical growth and development stages. Since plants absorb water through the root system, the water must be available in the root zone—either soaking down to that level from the soil surface or being pulled up from below through the soil layers. The soil acts as a reservoir—gathering, storing, and holding water until it is needed by plants. The soil type determines the ability of the soil to store water and release it as needed by plants. Since it is difficult to differentiate between water

WATER REQUIREMENTS FOR CROPS

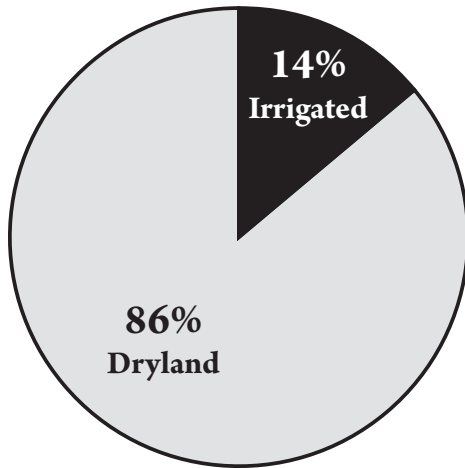
Crop	Water Requirement
Canola	Low
Oats	Low
Grain sorghum	Intermediate
Sunflowers	Intermediate
Wheat	Intermediate
Corn	High
Cotton	High
Soybeans	High

Source: K-State Research and Extension

Cropland

lost to evaporation and water released to the atmosphere through the process of transpiration, the term "evapotranspiration" is often used to describe the combination of water processes.

KANSAS CROPLAND: DRYLAND VS. IRRIGATED



Source: Kansas Agricultural Statistics Service

IRRIGATION

The amount of precipitation, water that falls in the form of snow or rain, varies greatly across the state of Kansas. Cropland is classified as irrigated or dryland (non-irrigated), depending on whether the precipitation falling on the land is supplemented with other sources of water or not. Irrigated cropland produces over 40 percent of the world's food supply.³ According to the Kansas Agricultural Statistics Service, around 14 percent of the cropland that is harvested each year in Kansas is irrigated. That irrigated cropland produces over 20 percent of the total value of the crops harvested in Kansas each year. Precipitation determines the need for irrigation water, which increases or decreases depending on the amount of rainfall during the crop's growing season and whether the rainfall occurs at the critical stages of growth and development. In Kansas, corn is the leading irrigated crop. A higher percentage of alfalfa acres in the state are irrigated than soybeans, even though the number of irrigated soybean acres in Kansas is higher than the number of irrigated alfalfa acres. All but two counties in Kansas (Elk and Woodson) have some irrigated land. Finney, Haskell, and Gray counties have the largest number of irrigated cropland acres in the state.⁴

Irrigating land to grow food and to grow feed for livestock is an agricultural practice that stretches back at least 5,000 years. Some of the earliest methods included diverting water from streams or rivers through ditches and irrigation channels and creating storage reservoirs to hold water by blocking the natural flow of water. Over time, irrigation methods were modified as agricultural practices changed and concerns about water quality or quantity were addressed. In Kansas, early settlers first tried to farm using the same methods they had



Chase County Windmill
Credit: John Charlton, KGS

used in eastern states or other countries, including irrigating crops using water from streams and rivers when necessary. In many areas of Kansas, those water sources were unavailable or unreliable so the pioneers relied on groundwater. They dug wells and by the late 1800s, many Kansans were relying on the wind to provide the power to pump water from the wells. In 1895, there were over 1,200 irrigators in the western half of the state—96 percent of those used wind power (windmills).⁵ Kansas established a state board of irrigation in 1895 to research, demonstrate, and promote irrigation in 20 counties in western Kansas. The first experimental pumping station was built at Goodland in Sherman County and irrigation plants were built in at least three other counties—Gray, Stanton, and Hamilton.⁶ Two years later, the irrigation stations and assets were sold when the state legislature reorganized irrigation efforts in western Kansas. The federal government also assisted in the development of the Garden City Irrigation project in Finney County while private irrigation companies formed and built irrigation canals in many areas of Kansas. Some succeeded but many early irrigation companies failed.

In the very first sentence of the 1955 Yearbook of Agriculture, Ezra Taft Benson, the U.S. Secretary of Agriculture, said "I have little need to remind you that water has become one of our major national concerns."⁷ In the 1940s and 1950s, new technologies developed that allowed water to be withdrawn in much larger quantities from the aquifers underlying central and western Kansas. Those cost-effective technologies drove an expansion in irrigated cropland in Kansas and surrounding states that in turn led to an expansion of the livestock industry in Kansas, particularly the livestock feeding, processing, and related industries in southwest Kansas. Irrigation equipment and methods have continued to be refined to conserve water, just as crop varieties have been developed to require less water even while increasing yields.

Kansas farmers continue to seek ways to use irrigation water more efficiently and reduce the demand on water resources. Today, the most common irrigation method in Kansas is the center pivot sprinkler with drop nozzles. According to the Kansas Department of Agriculture's Division of Water Resources, this system is used on over 1.9 million acres in Kansas, almost 62 percent of the irrigated land in Kansas. Center pivot systems fitted with low-pressure dropped nozzles can increase water-use efficiency by 85–95 percent according to the Groundwater Foundation. Newer sprinkler heads are adjustable and can be raised or lowered for each crop.

Water for irrigation is managed and regulated through a system of water rights (permits to use a set amount of water from a specific source for a specific purpose) administered by the Division of Water Resources of the Kansas Department of Agriculture. Today,



Flood Irrigation near Syracuse, 1939

Source: Library of Congress;
Russell Lee, photographer



Drilling for Water near Garden City, 1939

Source: Library of Congress;
Russell Lee, photographer



Center Pivot Irrigation with Drop Nozzles

Credit: Cindy Baldwin

new water rights for irrigation in Kansas are rarely issued and the state has developed new programs intended to promote water conservation and slow down declines in aquifer water levels. There are no simple answers or quick fixes to water issues. Plant roots will not grow when the soil is too dry. Simply shutting off irrigation wells and switching to dryland farming would have economic consequences far beyond the farms and families directly affected. Agriculture continues to take additional measures to use water more efficiently even as the potential impacts of cutting back irrigation on local, regional, state, and national industries and economies are being researched and considered.

KANSAS CROPS

"The greatest service which can be rendered any country is to add a useful plant to its culture."

Thomas Jefferson, 3rd President of the United States

Less than 20 percent of the land in the United States is used to grow crops, but in Kansas, over one-half of the land in the state is planted to crops each year. Kansas farmers produce a variety of crops, including wheat, corn, soybeans, grain sorghum, alfalfa, cotton, sunflowers, potatoes, pinto beans, oats, barley, canola, and fruit and vegetable crops.

KANSAS CROP SUMMARY

Kansas is known as the "Wheat State" because it consistently ranks at or near the top among the 50 states in the United States in the production of wheat, wheat flour milled, and wheat flour milling capacity. In addition, Kansas is the number one producer in the United States of wheat gluten, the natural protein derived from wheat and wheat flour. Kansas farmers produce one-fifth of all the wheat grown in the United States, according to the Kansas Wheat Commission.

Even though Kansas is called the "Wheat State," more bushels of corn



Wheat

Credit: Kansas Wheat Commission

2006 CROP PRODUCTION: HOW KANSAS RANKED AMONG THE 50 STATES

1st	wheat	291,200,000 bushels
1st	grain sorghum	145,000,000 bushels
2nd	sorghum for silage	600,000 tons
3rd	sunflowers	168,060,000 pounds
4th	all hay	6,550,000 tons
5th	summer potatoes	1,824,000 hundredweight*
7th	alfalfa hay	3,610,000 tons
8th	corn for grain	345,000,000 bushels
8th	pinto beans	210,000 hundredweight*
11th	corn for silage	3,600,000 tons
11th	soybeans	98,560,000 bushels
16th	cotton	140,000 bales**
* one hundredweight = 100 pounds ** based on 480 pounds per bale		

Source: Kansas Agricultural Statistics Service

than wheat are produced in the state according to the Kansas Agricultural Statistics Service. Kansas is among the top ten corn-producing states in the United States, producing nearly 4 percent of the corn produced for grain in the United States. Corn silage is also a major product in Kansas, with an average 2.5 million tons of silage harvested each year and used as livestock feed, mainly by the beef industry.



Corn

Credit: Lynn Betts, USDA NRCS

Each year, Kansas produces nearly 50 percent of the U.S. grain sorghum crop. Grain sorghum is also referred to as milo. The United States is the largest producer of grain sorghum in the world but in terms of acreage or dollar value, grain sorghum is not the largest or the most valuable crop produced in either the United States or the state of Kansas.



Grain Sorghum

Credit: High Plains Journal

Until recently, the United States was the world's largest exporter of soybeans. Today, the U.S. is still the largest producer of soybeans in the world and this country accounts for almost 40 percent of the world's soybean production. In the United States, soybeans rank second (behind corn) in the number of acres planted and the value of the crop produced. Soybean acreage is fluctuating in Kansas, a reflection of national trends. In 2004, soybean production in Kansas jumped 95 percent from the year before. Although Kansas only produces 3 to 4 percent

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of the soybeans produced in the United States, the state still ranks in the top ten states in soybean production according to the Kansas Agricultural Statistics Service.

Long before Kansas adopted the native wild sunflower as the state flower in 1903, Kansas was known as the "Sunflower State." Each year, around 150,000 acres in the state are planted to sunflowers. Kansas ranks third in both sunflower acreage and production among the states that produce sunflowers in the United States.

In Kansas, more farms grow alfalfa than corn. Kansas produces about five percent of the alfalfa produced in the United States and ranks eighth among the states in both alfalfa acreage and production. Unlike many Kansas crops, alfalfa is a perennial plant and stands of alfalfa are maintained for years, rather than months. Alfalfa is the most important forage crop grown in the United States.

Other field crops grown in Kansas include cotton, potatoes, pinto beans, oats, barley, and canola. Early Kansas farmers experimented with producing cotton but from 1943 until 1982, Kansas did not even keep official state production records on cotton. Today, cotton is making a comeback in Kansas and the annual cotton crop contributes millions of dollars to the state's economy. Kansas potato production is valued at over \$10 million annually while the state's average pinto bean production is valued at almost \$5 million. Oats and barley are grown for the cereal and food industry or for livestock feed. Canola is an oilseed.



Soybeans

Credit: Minnesota Soybean



Sunflowers

Credit: Bruce Fritz, USDA ARS



Alfalfa Bales

Credit: High Plains Journal



Cotton Plant

Credit: Scott Bauer, USDA ARS

AGRICULTURAL BIOTECHNOLOGY

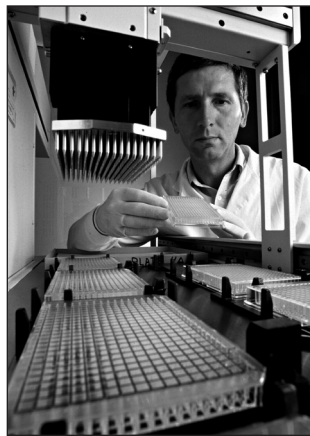
Just like the early Kansas pioneers, today's farmers and ranchers continue to research and experiment with a variety of crops that might meet industrial needs or provide new consumer products. Scientific research, including the selection of specific genes to improve plant qualities, is critical to maintaining the supply of food needed to feed the world's population and protect natural resources at the same time. Traditional plant breeding methods involved the transfer of thousands of genes at a time and it took several years to isolate the genes responsible for specific traits. Modern technol-



Sorghum Breeding

Credit: KSU Ag Research Center-Hays

ogy allows plant breeders to make precise genetic changes and address disease, insect, or environmental challenges more rapidly. In the United States, agricultural biotechnology, the technology used by plant breeders to add beneficial traits to plants, is regulated by three agencies: the U.S. Department of Agriculture's Animal



Gene Mapping

Credit: Scott Bauer, USDA ARS



Biotechnology Research

Credit: Keith Weller, USDA ARS

and Plant Health Inspection Service (APHIS), the Environmental Protection Agency, and the Food and Drug Administration's Center for Food Safety and Nutrition. Foods and plants produced using biotechnology are among the most tested food and agricultural products in history. Today, from 60 to 70 percent of the processed foods available in U.S. grocery stores contain at least one ingredient derived from agricultural biotechnology.⁸

KANSAS CROPLAND HISTORY

"What is the secret to success?"

"Two words: 'Right Decisions.'"

"How do you make the right decisions?"

"One word: 'Experience.'"

"And how do you get experience?"

"Two words: 'Wrong decisions.'"

Tim Nichols and Craig Wiseman, songwriters,

Live Like You Were Dying⁹

Most Kansas farmers and ranchers would agree that experience really is the secret to success. The early pioneers certainly experimented with a wide variety of crops and farming methods until they experienced success. Even then, they sought new information and employed new farming methods in search of continued success. Unfortunately, some of the experimentation also resulted in unanticipated negative consequences. Those experiences led to more research and experimentation and ultimately resulted in changes in agricultural methods and even societal values.

EARLY KANSAS AGRICULTURE

American Indians grew the first agricultural crops in the area that is now the state of Kansas. Early Spanish explorers observed the Quivira Indians cultivating the soil and the Kansa Indians served corn and other vegetables to other early explorers. In 1827, the federal government appointed Daniel Morgan Boone, son of the famous Kentucky hunter and trapper, to instruct the Kansa Indians at the Shawnee Methodist Mission in the "arts of agriculture."¹⁰ Farms were common on the lands reserved for the American Indians by the time Congress passed legislation creating the Kansas Territory in 1854. However, prior to the end of the Civil War, settlers in the Kansas Territory usually raised barely enough food for their own consumption and some years did not even manage to do that.

HUMAN MIGRATION

Emigrant – a person who moved (migrated) away from one region of a country to another region of the same country (as used historically).

Immigrant – a person who moves (migrates) into a different country.

KANSAS AGRICULTURE 1870s TO 1930s

After the Civil War ended, emigrants rushed into Kansas. Many were unemployed war veterans who came to try their luck in the new state. In the 1870s, the population of the state grew faster than the state's ability to feed its people. The state rallied in the 1880s under another wave of immigrants who tried new farming methods and crops. The land resources seemed endless and even more land was placed under cultivation as confidence grew in the new state, new crops, and new agricultural practices. The most fertile productive land was claimed first, but as settlers continued to pour into the state, marginal land—land that was not well suited for planting and growing crops—was pulled into production.

Since most of the early settlers came into Kansas from the eastern states, they were able to adapt familiar farming methods and crops to the climate and soils in eastern Kansas. As the settlers moved westward out into the prairie grasslands, they soon learned that things needed to be done differently. Some of the early settlers came from forested areas in eastern states where grasses like clover, bluegrass, and timothy were cultivated for grazing. They did not think that the native prairie grasses would support continued livestock grazing. Until the late 1880s, many people did not realize that the native bluestem, gama, and buffalo grasses needed to be preserved.

Many of the settlers arrived with horses or mules. The Kansas climate encouraged the development of horse-drawn machinery that could take advantage of soil moisture while it was available and harvest crops rapidly in between the periodic storms. In the 1870s, newer horse-drawn machinery allowed the farmer/operator to ride, rather than walk. One reason that growing wheat became more popular in Kansas than raising corn was because machines could be used to harvest and thresh wheat while corn still had to be harvested by hand.

Farmers and manufacturers continually worked to improve the machinery needed for agriculture in Kansas and other Plains states but there was no real consensus on the best way to farm the former grasslands. Beginning in the early 1860s, many people advocated deep plowing and scorned the farmers who barely scratched the surface of the soil when preparing the seedbed and planting crops. Some people even promoted



Cutting Corn, Sheridan County, 1939

Source: Library of Congress; Russell Lee, photographer



"Riding" Corn Planter, Jefferson County, 1936

Source: Library of Congress; Arthur Rothstein, photographer

EARLY KANSAS POPULATION GROWTH

1855	8,601
1860	107,206
1870	364,399
1880	996,096
1890	1,428,108
1900	1,470,495
1910	1,690,949
1920	1,769,257
1930	1,880,999

Sources: U.S. Census Bureau and Kansas State Historical Society

the theory that plowing opened the soil up so it could absorb and hold water and that plowing more land in Kansas would cause it to rain more often in the state!



Horse-Drawn Plow

Source: USDA NRCS

Despite prolonged periods of dry weather, severe economic distress, and extreme weather events (blizzards, tornadoes, windstorms, and dust storms), many families did manage to adapt to the Kansas environment. They continued to be optimistic about their opportunities to be more successful. They were supported by the efforts of the U.S. Congress and the state legislature. In 1862, Congress authorized and provided monetary support for an agricultural college in each state, which resulted in the selection of Manhattan, Kansas, as the site for the Kansas State Agricultural College (KSAC), now Kansas State University. In 1887, Congress authorized and provided for an agricultural experiment station in each state. In Kansas, the Experiment Station became a branch of KSAC. The Experiment Station's responsibilities included the testing of seeds, the introduction of new crops, plant breeding, soil analysis, studying crop rotation, and distributing research results. In 1900, the state of Kansas acquired the Fort Hays military reservation, part of which became a branch of the KSAC Agricultural Experiment Station and is now known as the Kansas State University Agricultural Research Center–Hays.

CHANGING KANSAS AGRICULTURE

1862 – Congress authorizes an agricultural college in each state.

1863 – Kansas Legislature establishes Kansas State Agricultural College (KSAC) in Manhattan, later renamed Kansas State University.

1867 – Congress authorizes an agricultural experiment station in each state; Kansas Agricultural Experiment Station becomes branch of KSAC.

1900 – State of Kansas acquires Fort Hays military reservation; establishment of Hays branch of Kansas Agricultural Experiment Station, later renamed Kansas State University Agricultural Research Center–Hays.

Cropland



Plow pulled by Steam Traction Engine, Belpre, 1910

Source: Library of Congress; Wm. O. Durstine, photographer

Beginning in the early 1900s, new developments in farm machinery allowed farmers to cultivate and harvest larger areas of land more quickly. During World War I, an increased demand for food in Europe pulled thousands of grassland acres into crop production. Much of the new cropland was planted to wheat, which intensified an existing problem caused by the Hessian fly. This insect lays its eggs in the stalks of the growing wheat plant, which is damaged when the eggs hatch and the larvae begin feeding on the plant material. In order to combat the Hessian fly problem, Kansas farmers were instructed to work the ground as soon as the wheat crop was harvested, plow deep to bury the wheat stubble, and keep tilling the soil until all the volunteer wheat had sprouted and been destroyed. Today, Kansas farmers deal with the Hessian fly problem by destroying volunteer wheat shortly after harvest, planting after the egg-laying period has ended in the fall, and choosing varieties with genetic resistance to the problem. However, starting in the early 1900s, Kansas farmers acted according to the recommendations available at that time which told them to plow deep and work the fields often if they or their neighbors were planning to plant wheat.



Hessian Fly

Credit: Scott Bauer, USDA ARS

In the mid-1920s, smaller lightweight tractors became more affordable. By 1930, most farmers were using tractors, rather than horses, to produce crops. Land that had grown feed for the horses and mules became available for crop production and the tractors made it possible to farm more acres, increasing the size of many farms.



Planting with both Horses and Tractor, 1940

Source: John Vachon, USDA

THE DUST BOWL

For thousands of years, whenever people used up or damaged the natural resources in the area where they were living, they simply moved to a new location. In the United States, pioneers moved further inland as the population of the country grew. People rode across the prairie grasslands on their way west—or east—but few people understood the potential of the prairie states and many believed "The Great American Desert" was an accurate description for the area. Once homesteaders staked their claims in the Plains states, there were very few opportunities left to claim "new" land or natural resources in the United States.



Dust Storm

Source: USDA NRCS

There were warning signs that bringing the prairie grasslands under cultivation would have long-term consequences. A series of intermittent dry years in the late 1800s, prairie fires, and overgrazing contributed to dust storms that blocked railroad tracks with drifts of dust, killed livestock, and filled homes and buildings with tons of topsoil. When the rains and snows returned, the farmers planted and harvested crops, and turned even more grassland into cropland. Additional grassland was converted into cropland during World War I. When prices dropped after the war ended, many landowners chose to leave some cropland unplanted, abandoning it until prices rose again. The dry years came before that happened.

In the 1930s, a widespread severe drought affected the entire country. In 1934, over 80 percent of the United States experienced extremely dry conditions. The driest region included the southwest area of Kansas, southeastern Colorado and the panhandles of Texas and Oklahoma. The eight years from 1933 to 1940 are known as the drought years of the period called the "Dust Bowl." However, the dust storms started as early as 1932 in the Plains states. By 1934, an estimated 100 million acres of farmland had lost all or most of its topsoil due to wind erosion. During the Dust Bowl, red-colored soil from Oklahoma was blown as far north as Canada and as far east as the Atlantic Ocean.



Soil Drifts around Barn, Liberal, March 1936

Source: Library of Congress; Arthur Rubenstein, photographer

DUST BOWL FACTS
The eight years from 1933 to 1940 have been designated as the Dust Bowl period, even though dust storms in the Plains states started in 1932.
April 14, 1935 is known as "Black Sunday"—one of the worst dust storms in the history of the United States occurred on that day.
On April 27, 1935, the passage of national soil conservation legislation coincided with a dust storm that blew into Washington, D.C., while Congress was in session.
During the Dust Bowl period, the driest region in the United States included southwestern Kansas.



Dust Storm

Source: USDA NRCS

One storm in May of 1934 that started in Montana and Wyoming carried soil 300 miles out into the Atlantic Ocean. By some estimates, that single storm carried up to 350 million tons of soil. In March of 1935, the regional high school basketball tournaments at Garden City and Hays were cut short by a dust

storm. The dust got so bad that—even with the lights on—players could not see from one end of the basketball court to the other.¹² One of the worst dust storms occurred on Sunday, April 14, 1935, which became known as "Black Sunday." The next day, a reporter used the term "Dust Bowl" to describe the driest area of the continent. Over time, the term also became associated with the time period and the dust storms.

Even before "Black Sunday," government leaders were considering soil conservation issues. They understood that the country needed to protect its soil resources and assist farmers in implementing agricultural practices that prevented further soil erosion. Hugh H. Bennett led those efforts.

SOIL CONSERVATION SERVICE

Hugh Bennett joined the Bureau of Soils in the U.S. Department of Agriculture in 1903 as a technician whose main work was to classify and map the soils across the country. He understood the soil and its permanence but also recognized its fragility. Bennett wrote articles and spoke regularly about the "national menace" of soil erosion. On April 27, 1935, Bennett testified before Congress about the importance of creating a new national soil conservation program that would teach good management of the country's soil. Coincidentally, at the same time, a major dust storm was brewing. The dust storm blew into Washington, D.C., blackened the skies and helped Bennett persuade Congress to take proactive measures. That day,

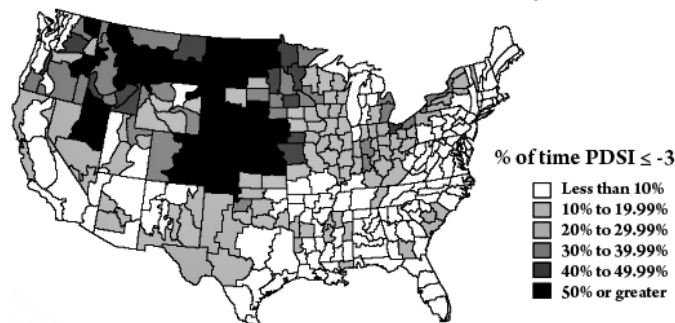


Hugh H. Bennett

Source: USDA NRCS

PALMER DROUGHT SEVERITY INDEX 1934–1939

Percent of Time in Severe and Extreme Drought



Source: National Drought Mitigation Center

Congress passed Public Law 46 – the Soil Conservation Act of 1935 and the basis for all national soil and water conservation programs today. That law established the Soil Conservation Service in the U.S. Department of Agriculture. Hugh Bennett was appointed the first chief of the Soil Conservation Service, reorganized as the Natural Resources Conservation Service in 1994.

Despite the ongoing drought, which coincided with and contributed to the Great Depression, the Soil Conservation Service immediately began efforts to highlight conservation activities beneficial to the land and soil. Those early efforts were not successful, in part because the information was too technical and confusing. A lack of local leadership and coordination as well as the lack of financial resources also threatened the successful adoption of soil conservation practices.

SOIL AND WATER CONSERVATION TIMELINE

1930s –severe drought affects the United States.
1935 – Congress passes the Soil Conservation Act of 1935, the basis of all national soil and water conservation programs.
1935 – Soil Conservation Service (SCS) established in the U.S. Department of Agriculture.
1937 – Kansas legislature passes the Kansas Conservation Districts Law. Kansas law establishes the State Soil Conservation Committee, later renamed the State Conservation Commission.
1938 – first county conservation district formed in Kansas (Labette County).
1944 – Kansas Association of Conservation Districts (KACD) organized.
1954 – last of 105 county conservation districts established in Kansas (Shawnee County).
1994 – SCS reorganized as the Natural Resources Conservation Service (NRCS).

STEWARDSHIP WEEK

Since 1955, the National Association of Conservation Districts has sponsored the national Stewardship Week program. Stewardship Week focuses on the power of individuals to protect natural resources through education, personal actions, and responsible use.

SOIL CONSERVATION DISTRICTS

In February 1937, President Franklin D. Roosevelt sent a letter to each state governor urging the states to pass legislation establishing state soil conservation programs similar to a model Conservation District Law developed by Congress. In March 1937, Kansas passed the Kansas Conservation Districts Law, becoming the second state to authorize the creation of conservation districts. The law also established a State Soil Conservation Committee, later re-named the State Conservation Commission, to promote soil and water conservation. Today, the State Conservation Commission provides leadership and guidance to local conservation districts, administers financial assistance programs, and coordinates conservation activities across the state with many other organizations.

In June 1938, the Labette County Conservation District became the first authorized conservation district in the state of Kansas. There are conservation districts in each of the 105 counties in the state, including Shawnee County, which (in 1954) was the last county to form a conservation district. Local agricultural producers and landowners serve on the conservation district boards, which provide nonpolitical leadership, encourage local participation in conservation activities, and coordinate the efforts of local, state, and national agencies to conserve, maintain, and improve soil and other natural resources on private lands.

The 105 county conservation districts belong to the Kansas Association of Conservation Districts (KACD). The KACD is a nonprofit, nongovernmental, voluntary organization that serves as a voice for the conservation districts on state policy, legislation, and communication.

Kansas farmers continue to benefit from the partnerships formed during the 1930s when the future of agriculture in Kansas and other Plains states looked very bleak. Scientific research and experimentation carried on at Kansas State University and the Agricultural Research Centers across Kansas address specific crop and livestock needs and distribute research results through educational programs offered by K-State Research and Extension offices located in each county. Several local, state, and national agencies provide technical knowledge and financial assistance, including the Natural

KANSAS BANKERS AWARDS

Since 1945, the Kansas Bankers Association has sponsored Soil Conservation Awards to recognize farmers and ranchers who have completed high-quality soil conservation work. In each county, a local committee selects the award recipients each year. The committee considers the quality and maintenance of completed conservation work, along with the use of the land, the completeness of the conservation plan, and special conservation practices addressing energy, forestry, grassland, pollution control, or wildlife habitat conservation. The Kansas Bankers Association also sponsors Windbreak, Wildlife, and other awards. Each local conservation district office maintains a list of all award winners.

Resource Conservation Service, the State Conservation Commission, and the U.S. Department of Agriculture. Those resources are often coordinated through the conservation districts, which continue to provide local leadership in soil and water conservation.

SOIL AND WATER CONSERVATION

"The finest workers in stone are not copper or steel tools, but the gentle touches of air and water working at their leisure with a liberal allowance of time."

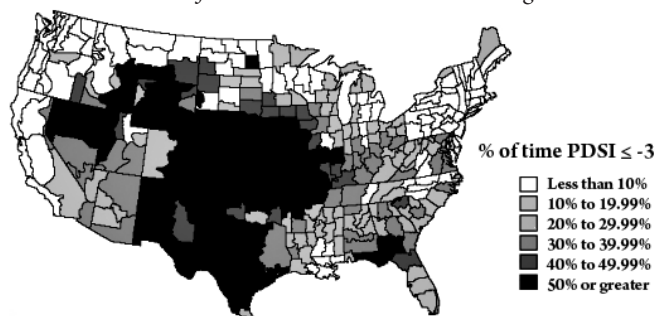
Henry David Thoreau, writer, philosopher, and naturalist

Since the 1930s, there have been other periods of severe and widespread drought but the United States has not experienced another catastrophic Dust Bowl. At the same time, U.S. farmers and ranchers have produced enough food to keep up with an expanding population in the United States while supplying agricultural exports and food aid for the increased worldwide population. Agricultural producers manage natural resources while maintaining the productivity of the land by using the appropriate soil and water conservation practices.

Crop production may involve any combination of cropping practices and tillage operations. Tillage includes mechanical manipulation of the soil, modification of soil conditions (adding nutrients, water, or lime), management of crop residues and weeds, incorporation of chemicals for crop production, or any combination of those actions. Common cropping practices in Kansas include crop rotation, growing a planned sequence of crops versus continuously growing only one crop on the same area of land, and summer fallow, leaving the land idle during at least one growing season to accumulate moisture in the soil for the next year's crop.

**PALMER DROUGHT SEVERITY INDEX
1954-1956**

Percent of Time in Severe and Extreme Drought



Source: National Drought Mitigation Center

SOIL EROSION

Kansas farmers balance crop production with soil and water conservation activities to minimize the loss of water and valuable topsoil. When wind or water moves topsoil, the soil carries away nutrients needed by crops. As demonstrated by the dust storms of the 1930s, wind erosion can be a problem in Kansas, especially when it is very dry in the late winter and early spring. In western Kansas,

Wind speeds as low as 13 miles per hour can cause soil particles to begin moving if the soil is highly erodible.

Source: K-State Research and Extension

RESIDUE LEVELS

Crop	Snow Catch Potential
Corn	High
Grain Sorghum	High
Winter Wheat	High
Canola	Intermediate
Millet	Intermediate
Oats	Intermediate
Sunflowers	Intermediate
Cotton	Low
Soybeans	Low

Source: K-State Research and Extension

much of the cropland now in the Conservation Reserve Program was selected on the potential for wind, not water, erosion.

Losses in agriculture due to water erosion can also be devastating. Even the impact of millions of raindrops hitting the soil can cause erosion, referred to as "splash erosion" in this case. Runoff occurs when the intensity or volume of rainfall exceeds the absorption and storage capacity of the land's surface, the soil itself, vegetation growing in the soil, and any residue on top of the soil.



Splash Erosion
Source: USDA NRCS

For example, if it rains when the ground is frozen, less water can enter the soil than at other times of the year. If rain comes down too hard or too fast, the water does not have time to seep down into the lower layers of soil and runoff occurs once the top layer fills with water.

CROP PRODUCTION PRACTICES

Continuous cropping— planting only one crop on the same land for two or more consecutive growing seasons; for example, planting wheat in the fall on the same field where wheat was harvested in the summer.

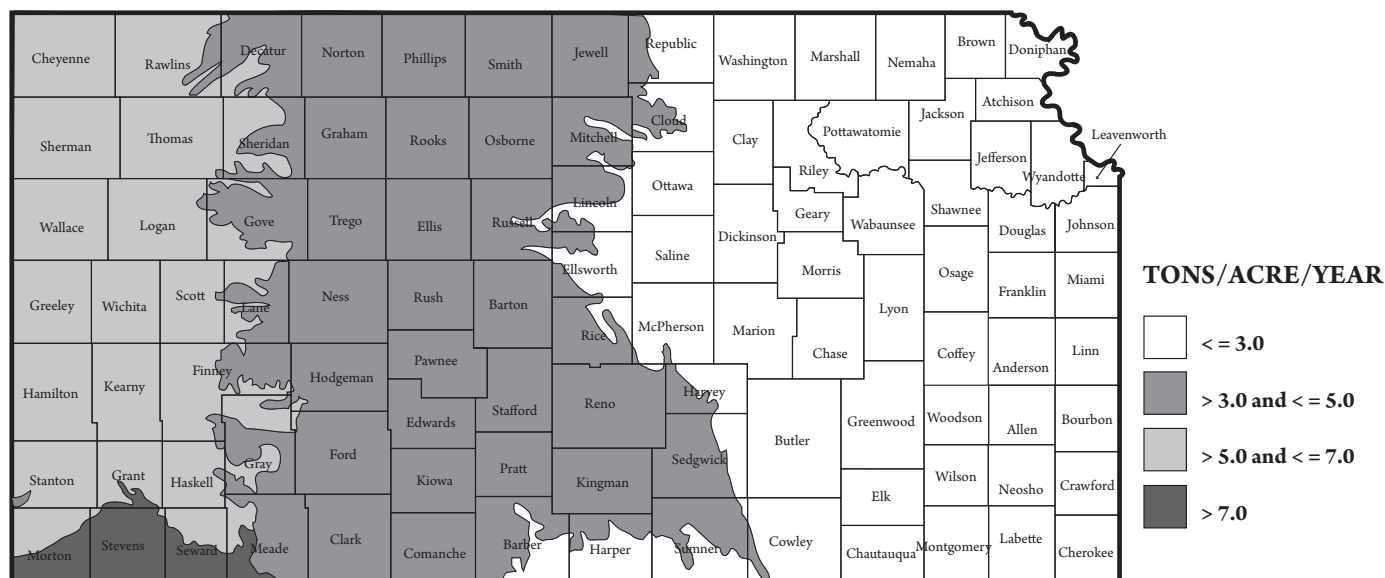
Crop rotation— growing a planned sequence of crops on the same land.

Summer fallow— leaving the land idle (not planted) during at least one growing season; also called ecofallow.

Sediment is a key word related to soil and water conservation and water quality. Sediment refers to particles resulting from rocks, soil, or organic matter moved by water or wind and deposited in a new location. Once the soil particles are picked up and carried away, the water deposits the sediment wherever the water slows down, either down lower on the slope or downstream. The water also carries the nutrients and chemicals attached to the soil particles away from the plants that need them. Eventually, the sediment can move into streams, rivers, and lakes and influence water quality. The timing, intensity, amount, and location of natural precipitation is still beyond the control of Kansas farmers and ranchers. However, by applying conservation practices that keep nutrients, soil, and water on the cropland, they can continue to produce crops while maintaining and improving Kansas soils.

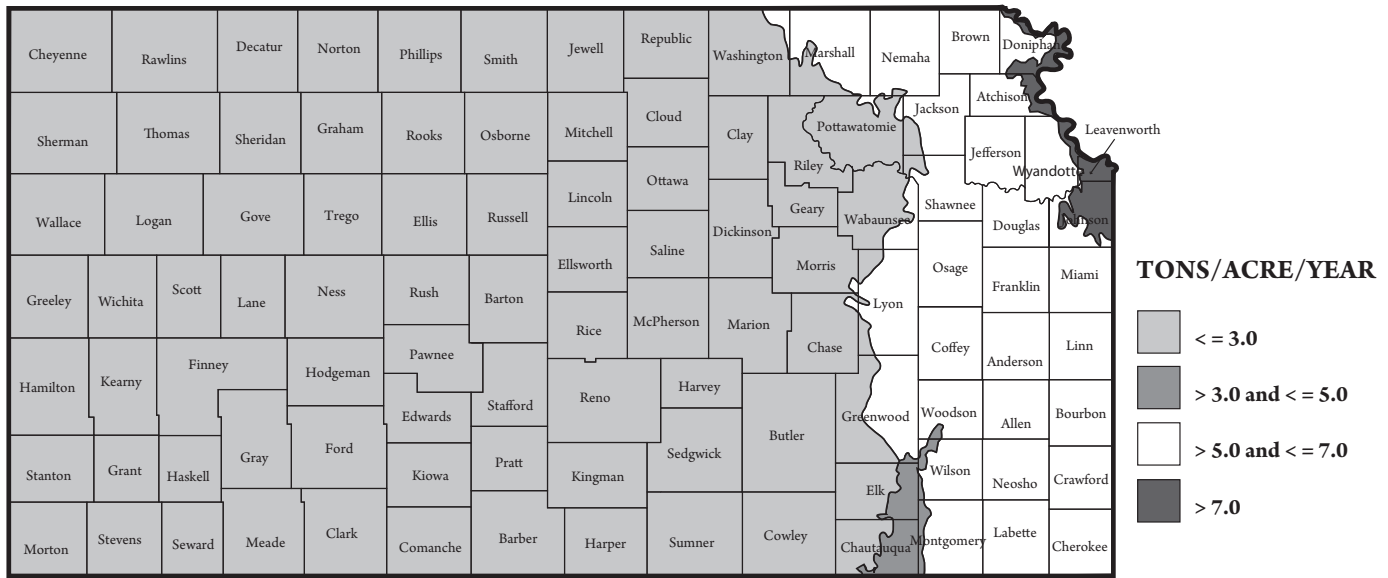
Kansas farmers have made huge strides in their ability to reduce water erosion losses on the croplands of the state. Three general principles guide soil and water conservation practices: changing the surface of the soil to increase the ability of water to penetrate gradually into the soil layers, slowing down the movement of water along the top of the soil to give the water more time to soak into the soil, and managing crops to take advantage of natural precipitation

KANSAS CROPLAND SOIL LOSS – WIND EROSION



Source: K-State Research and Extension

KANSAS CROPLAND SOIL LOSS – WATER EROSION



Source: K-State Research and Extension

CONSERVATION WORDS
Conservation tillage – any tillage sequence or tillage and planting combination that leaves at least 30 percent of the soil surface covered by the residue of the previous year’s crops.
Erosion – transportation of soil due to wind or water movement.
Runoff – water that is not absorbed by soil.
Sediment – particles resulting from rocks, soil, or organic matter moved by water or wind and deposited in a different location.
Splash erosion – erosion resulting from the impact of raindrops hitting the soil.
Tillage – preparation of land for crop production.

patterns. The goal is to limit the water's ability to flow along the top of the soil—keeping the soil in place and the water on the land where it fell.

Many of the same conservation practices also reduce wind erosion. Wind speeds as low as 13 miles per hour can cause soil particles to start blowing if the soil is highly erodible (i.e. the soil surface is dry, smooth, loose, finely granulated, and unprotected by residue). In areas where soils are vulnerable to wind erosion, additional conservation measures are taken. These might include planting crops at an angle to the prevailing winds or alternating wide strips of growing crops with strips of stubble from previous crops.

TILLAGE

At one time, most tillage methods consisted of breaking up the soil, pulverizing any large clods or clumps of plant material, and smoothing out the soil, thus reducing soil particle size and creating a smooth, finely ground seedbed. Today, Kansas farmers use a wide range of tillage methods, generally choosing the minimum

necessary to meet crop production requirements for yield production goals. They decide which tillage methods to use based on a number of factors, including but not limited to, the crops that are being grown, the existing soil and climatic conditions, and economic factors such as fuel costs. Most tillage methods create rough surfaces, increase subsoil water storage capacity, and leave part or all of the residue from previous crops on or near the surface of the soil. In addition to more conventional tillage operations, Kansas farmers may practice conservation tillage, no-till farming, strip tillage, and summer fallow (ecofallow).

Conservation tillage is any tillage sequence or tillage and planting combination that leaves at least 30 percent of the soil surface covered by the residue of the previous year’s crops. Research on conservation tillage began in the 1930s in the United States. Since the mid-1960s, conservation tillage practices have become more common in Kansas.

No mechanical manipulation of the soil takes place on cropland that is no-tilled. **No-till farming** is a continuous process requiring special planting equipment since no tillage takes place between the harvest of one crop and the planting of the next. During the planting process, less than 10 percent of the soil surface and existing crop residue are disturbed. The planting equipment prepares



Conservation Tillage

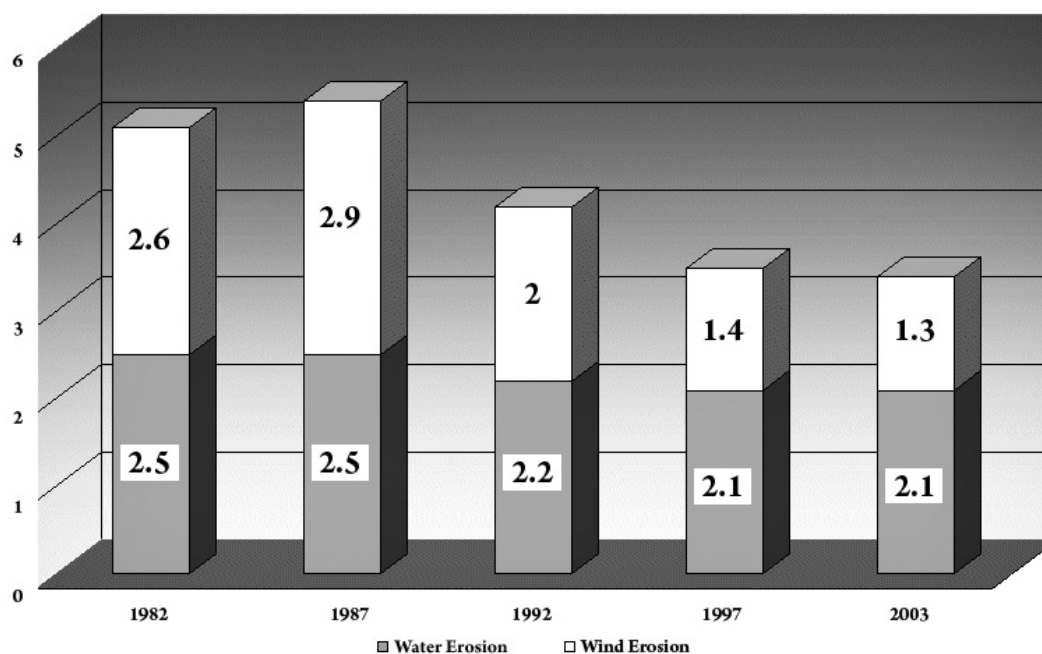
Source: USDA NRCS



No-till Farming

Source: USDA NRCS

EROSION ON KANSAS CROPLAND BY YEAR (TONS/ACRE/YEAR)



Source: USDA NRCS

a seedbed, deposits the seed, and leaves the surface of the soil and the crop residue virtually undisturbed. The residue helps retain any natural precipitation or water applied to the land by irrigation and minimizes soil and nutrient losses. No-till management practices also reduce soil water losses due to evaporation and can reduce soil erosion from crop fields significantly.

Strip till, also called zone tillage or strip till planting, is a method of tilling and planting in narrow rows (strips). The soil and residue is left undisturbed in between the six- to eight-inch-wide rows. Special equipment is required for strip till farming. Depending on the type of equipment purchased, the seedbed will be prepared at the same time that the seed is being planted or two separate trips through the field for tilling and planting will be required. Precise farming methods, such as global positioning systems (GPS) and autosteer guidance systems, may be used to more accurately place fertilizer and seed in the same narrow strips of soil crop after crop.

Historically, **summer fallow** was the main dryland cropping system in western Kansas. In the traditional cropping pattern, after two wheat crops, a field would be idled (left fallow or unplanted) for 14 to 15 months to build moisture in the soil profile for future crops. As necessary, weed growth would be controlled with shallow cultivation, which in turn allowed some soil moisture to evaporate. As Kansas farmers began rotating wheat with other crops, the fallow periods became shorter—limited to the growing seasons of the different crops rather than the entire cropping year for a single crop such as wheat. The development of herbicides allowed farmers to control weed growth during the fallow periods without losing moisture during the process of cultivation. Today, **ecofallow** is another term used to describe the system of rotating crops with fallow periods. Examples of current ecofallow rotations might include: wheat – grain sorghum – fallow, wheat – wheat – grain sorghum – fallow, or wheat – corn – fallow.

MANAGING LAND AND NATURAL RESOURCES

Kansas farmers apply a variety of conservation practices such as farming on the contour, strip cropping, building terraces and grassed waterways, and planting buffer or filter strips to minimize soil and water erosion of Kansas cropland. New technologies assist Kansas farmers with the placement of nutrients and the efficient use of water resources.

Contour farming can reduce erosion dramatically. When a field is farmed on the contour, all the tilling and planting operations go around or back and forth across the slope of the land. The furrows wrap gently around the slope and each acts as a small dam, preventing water from running wildly down the slope. Instead, the water goes down the slope a little at a time in much the same way that a car would wind down a very steep mountain, rather than driving straight down from top to bottom. Farming on the contour can reduce soil and water losses by as much as 50 percent.¹¹



Contour Farming

Credit: Jeff Vanuga, USDA NRCS

Strip cropping may be combined with contour farming, alternating strips of planted crops throughout the field to limit soil and water losses even more. For instance, a strip of small grains (wheat, oats, or rye) or a strip of legumes (alfalfa or clover) might be planted among strips of spring-planted row crops which are typically the most erosion-prone because the small seedlings cannot stop much water and soil movement during early spring rains. Strip



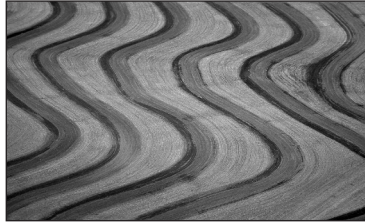
Strip Cropping Corn

Credit: Gene Alexander, USDA

Cropland

cropping is also used to prevent wind erosion. Strips (several rows wide) are planted perpendicular to the prevailing wind direction so that the wind blows across the rows of plants, rather than down the furrows. Wide strips of stubble, standing crop residue from a previous crop, are alternated with the strips of growing crops to catch any soil particles that might start moving with the wind.

A **terrace** is a raised, generally horizontal ridge of earth embankments constructed across a slope, following the contour of the land. A shallow channel on the uphill side of the terrace is designed to capture water and slow it down, while the terrace redirects the water



Kansas Terraces

Credit: Jeff Vanuga, USDA NRCS

into slower moving channels such as grassed waterways or outlets. Terraces are designed to be capable of controlling the water runoff from a 10-year storm event (the heaviest rainfall to be expected once in 10 years). There are many types and sizes of terraces but in Kansas, most terraces are farmed at the same time and in the same way as the rest of the field. Through the Conservation Reserve Program, some terraces have been permanently planted to grass while crops are still grown on the land between the terraces. The many miles of terraces on Kansas cropland create an artwork on the land.

Grassed waterways are natural or constructed channels used to carry water from natural precipitation through or from cropland. Water flows into these broad shallow channels, which are planted to grass. The grass provides cover for the soil and the soil stays intact when there is water runoff.



Waterways

Credit: Tim McCabe, USDA

The grass also serves as a net and catches any particles in the flowing water. Water moves along the grassed waterway until it reaches a holding area, such as a pond, or leaves the field.

Buffer strips, filter strips, and field borders are other strips of vegetation that slow water down and trap sediments. **Field borders** are strips of perennial grasses or legumes along and around the edge of a cropland field.



Buffer Strip

Credit: Jeff Vanuga, USDA NRCS

Buffer strips or **filter strips** are strips of permanent vegetation (grasses, trees, and shrubs) planted along bodies of water including streams, rivers, ponds, and lakes. Water slows down as it passes through the vegetation and sediments are trapped there. Any nutrients attached to the soil particles are also trapped and deposited where the plants or trees can use them.

Precision agriculture, or precision farming, incorporates several technologies using computers and/or satellites. These technological tools may include global positioning systems (GPS), geographi-

PRECISION AGRICULTURE TOOLS

Autosteer— automatic guidance system that operates agricultural machinery using GPS for accuracy and GIS information to vary operations at specific sites; requires human operator monitoring while following a sequence of computerized instructions that allow "hands free" steering.

Geographical information system (GIS)— computerized system of collecting, analyzing, and displaying information specific to geographical references.

Global positioning system (GPS)— navigational tool based on satellites orbiting the Earth and transmitting signals allowing GPS receivers to determine the receiver's location, speed, and direction.

cal information systems (GIS), automatic guidance systems (autosteering), yield monitors, and remote sensors. Information about soil and crop conditions is collected and analyzed so that inputs (seeds, nutrients, water, and chemicals) can be varied according to the needs of the



GPS Automatic Guidance System

Credit: Trimble Navigation

crop at site-specific locations, rather than applied at the same rate across the larger field. Computerized yield monitors on harvesting machines help farmers pinpoint locations where there might be problems affecting crop production. Automatic guidance systems can steer and operate agricultural machinery more accurately and efficiently than human operators. Autosteering reduces any overlap or "skips" as the machinery passes through the field. It also allows operators to return to the same locations time after time, especially important in strip till planting where the seed is placed into the same narrow strip of soil each growing season. Irrigators use remote sensors to monitor crop conditions and apply irrigation water more efficiently. As the new technologies become more affordable and practical for different types of farm situations, precision agriculture will become more commonplace in Kansas agriculture.

ANIMAL FEED AND WILDLIFE HABITAT

"I know of no pursuit in which more real and important services can be rendered to any country than by improving its agriculture, its breed of useful animals, and other branches of a husbandman's cares."

George Washington, First President of the United States

Animals were very important to early Kansas settlers. Horses and mules provided transportation and power. Domestic and wild animals provided food and materials for clothing, furnishings, and other household needs. Farms and ranches raised crops to provide feed for the livestock, as well as food for the people living and working there. While people dreamed of being self-sufficient, in reality, most families traded surplus agricultural products with other families or merchants to get everything they needed or wanted.

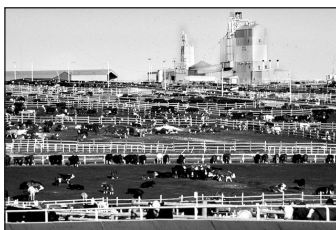
With each new development in farm machinery, individual farmers could do more fieldwork in less time and the size of farms grew. At the same time, transportation, manufacturing, and other industries provided easier access to many items for those people who had surplus agricultural products to sell. Eventually, tractors and automobiles replaced horses and mules on most Kansas farms. Until after World War II, though, most of those farms still produced a mixture of both crop and livestock products. Today, many farms and ranches in Kansas specialize in either crop or livestock production. Many others are still diversified - involved in both segments of agricultural production.

KANSAS BEEF INDUSTRY

The beef industry in Kansas is an example of an agricultural industry that includes both producers who specialize in beef production and those who combine crop and livestock production. Producers who specialize in crop production also play a vital role in supplying the grains and feed for the leading agricultural industry in the state of Kansas.

Beef is big business in Kansas. In fact, Texas is the only state with more cattle than Kansas. However, Kansas ranks first among the states in the number of cattle commercially processed each year. Nearly 25 percent of all the cattle fed for meat production in the United States are fed in Kansas.

The beef industry played an important role in the development of the state, from early cattle ranches and famous cowtowns to the big stockyards in Kansas City and Wichita. However, until the late 1960s and early 1970s, Iowa was the top cattle-feeding state. New developments in irrigation technologies led to increased crop production in central and western Kansas where the drier climate is more favorable for cattle feeding. Processing facilities moved closer to the feedyards and brought new jobs and industries to the state.



Beef Feedlot

Credit: Tim McCabe, USDA

In Kansas, the beef industry utilizes cropland in many ways. Each use is customized to the area of the state, field conditions, and each individual farm's operations and plans. After a crop is harvested, cattle may be allowed to graze on the crop residue, such as stalks and leaves of grain sorghum or corn. In some areas of the state, winter wheat grows fast enough to allow some grazing early in the fall without hurting yields significantly the next summer. Manure from feedyards, used as a source of nitrogen fertilizer on croplands, also increases the organic matter in the soil.

Using crops such as grain sorghum, corn, and wheat, the production of ethanol generates coproducts such as distillers grains, used as a high-quality feed ingredient in the beef feeding and dairy industries. As more ethanol plants go into production in Kansas, distillers grains will play a larger role in the state's livestock industry.

OTHER KANSAS LIVESTOCK

Other livestock such as dairy cattle, swine, sheep, horses, poultry, and bison also benefit from the resources provided by Kansas cropland. Even though none of these livestock industries is near the size of the Kansas beef industry, all make a positive impact on the Kansas economy.

The value of the milk produced by the **Kansas dairy industry** is over \$300 million each year. There are only 900 dairy operations in Kansas—"operation" meaning any place having one or more milk cows on hand at any one time. However, all together, there are 110,000 dairy cattle in Kansas, barely over 1 percent of the U.S. total. Back in the 1930s, there were almost 900,000 dairy cattle in Kansas, but the numbers began dropping after World War II as better refrigeration and packaging became available. Today, there are 20 dairies in Kansas with more than 500 dairy cattle each. Together, those 20 dairies produce over 270 million gallons of milk each year. High-quality alfalfa is one of the most important feeds for dairy cattle, which require very specific nutrients from feed mixtures to achieve their genetic potential for milk production. Alfalfa is also a natural source of calcium, which is an important nutrient for milk production.



Dairy Cow

Credit: Peggy Greb, USDA ARS

According to the Kansas Pork Association, Kansas pork producers spend about \$145 million each year for feed grains, primarily grain sorghum but including corn and soybean products. The **Kansas swine industry** includes 1,400 farms with 1.8 million hogs and pigs that eat over 30 million bushels of grain each year. In 2006, Kansas farmers marketed live animals valued at over \$370 million and produced nearly 900 million pounds of pork. Even though the number of hogs in Kansas was twice as high in the 1890s as it is today, the swine industry is a significant part of the Kansas economy.¹³



Pig

Credit: Scott Bauer, USDA ARS

In Kansas, the number of farms with sheep and swine are about the same. Sheep numbers peaked in Kansas in 1943 at 1.61 million, but started dropping dramatically in the 1960s and, at 77,000 head in 2007, are the lowest they have been since the 1860s. Today, the principal product of the **Kansas sheep industry** is lamb, meat from an animal that is less than one year old.

The **Kansas livestock industry** includes many other animal species. Some species, such as horses and mules, have been in the state for a long time. Although the Agricultural Statistics Service does not track the number of horses in Kansas, the American Horse Council has reported that there are 9.2 million horses in the United States, and the equine industry has an annual economic impact of \$39 billion. Other species, like bison, vanished from the Kansas prairies in the 1870s. Brought back from the edge of extinction, today small herds of domestic bison roam Kansas grasslands and contribute to the agricultural economy. Poultry, including those producing specific products such as eggs, provide local markets for crops, generate agriculture-related jobs, and contribute to the local and state economies. The number of meat goats in Kansas is rising rapidly in response to the increasing demand for those meat



Chicken

Credit: USDA

Cropland

products. Kansas croplands provide high-quality feed ingredients designed to meet the specific nutritional needs of the wide variety of livestock species in the state.



Source: USDA NRCS

KANSAS WILDLIFE

The agricultural lands of Kansas support an abundant and diverse wildlife population. Kansas wildlife species also take advantage of the high-quality feeds produced on Kansas cropland. Deer are plentiful in the state now but after they were driven out of the state while it was being settled, deer were rarely seen in Kansas. In the 1950s, deer started drifting back into the state and today, deer populations are high enough that deer-vehicle collisions are a major problem in Kansas. Deer in Kansas feed mainly on agricultural crops, such as corn, alfalfa, grain sorghum, wheat, and soybeans. Historically, wild turkeys were part of the prairie biome and were hunted by the American Indians and early Kansas settlers. Loss of habitat and lenient hunting laws led to the disappearance of the turkey in Kansas until a strong reintroduction effort was launched in the late 1960s and

early 1970s. Other species, such as the ring-necked pheasant, are not native to the state but thrived in the state after being released here by state wildlife officials. There are 467 species of birds found in Kansas. This includes birds like the ducks and geese that migrate through the state in the spring and fall as well as birds that are year-round residents of the state. The soil and water conservation practices of today's Kansas farmers benefit wildlife in addition to feeding domestic livestock.

EARTHWORMS

Although technically an invertebrate rather than an "animal," earthworms are very important to Kansas farmers and ranchers. Earthworms improve the soil as they tunnel through it, mixing the soil, shredding plant residue, and burying the residue in the soil. Earthworms swallow soil, tiny bits of plants, and microorganisms as they work their way up and down through the soil layers. As earthworms digest soil and excrete waste (worm castings), nutrients are deposited in the lining of tunnels created by the burrowing activity. Worm castings also contain microorganisms that help convert nutrients into forms that can be used by plants. The tunneling activity creates openings for water and air to move through the soil, particularly necessary when tillage is not used to break up the surface of the soil as in no-till farming. The tunnels also create spaces where the roots of a plant can grow. As a plant's root system pulls water through the tunnels left by the earthworms, the plant also receives nutrients, including those deposited in the worm castings. The presence of earthworms is usually a good indicator of a healthy soil system.

CROP-BASED FUELS

Ethanol— fuel produced from grains and plants high in starches; mixed with unleaded gasoline before it is sold to consumers.

Biodiesel— fuel produced from vegetable oils, animal fats, or recycled cooking oils; mixed with petroleum diesel fuel before it is sold to consumers.

CROP-BASED FUELS

"I said, ah ha, this is a light at the end of the tunnel, a way we can grow our way out of some of the problems we are in."

Willie Nelson, entertainer and songwriter

According to the federal government, renewable energy accounts for around 6 percent of the energy currently consumed in the United States. Fuels produced from crops and agriculture-related products can replace traditional energy sources, such as petroleum and coal, and reduce the United States' dependency on foreign imports. Groups such as the 25 x '25 coalition promote increased use of renewable fuels in the United States. The goal of the 25 x '25 coalition is to find ways to produce 25 percent of the nation's energy from renewable resources by 2025. Those renewable resources will include agricultural products, including Kansas crops.

Kansas crops are already being used to produce ethanol and biodiesel, fuels that are efficient and have positive health and environmental benefits. The biofuels industry is rapidly expanding, both in the United States and around the world. Crop-based fuels such as ethanol and soy biodiesel are considered biofuels. However, biofuels can be produced from many different biomass products and are not limited to crop-based components.

25 x '25 GOAL

The goal of the national 25 x '25 coalition is "By 2025, America's farms, forests, and ranches will provide 25 percent of the total energy consumed in the United States, while continuing to produce safe, abundant, and affordable food, feed, and fiber."



ETHANOL

Ethanol (ethyl alcohol) is produced from grain high in starches, such as corn and grain sorghum. In Kansas, historically, more grain sorghum was used in ethanol plants than corn although that was not the case nationwide. Corn and grain sorghum are interchangeable in the ethanol making process. Most of the new ethanol production facilities use the "dry milling" method to produce ethanol, which grinds the grain into flour before beginning a fermentation process. During the fermentation process, only the starch (carbohydrate) component of the grain is converted into alcohol. The dry milling process produces three products: alcohol (ethanol), distillers grains and carbon dioxide. Distillers grains are fed to livestock and the carbon dioxide is used in food processing and bottling as well as the petroleum industry.

Before it is sold to consumers, ethanol is blended with gasoline. The first ethanol-blended gasoline in the United States was available in the 1970s and was called “gasohol.” Today, ethanol is blended into nearly 50 percent of the fuel supply in the U.S. Every major automaker in the world has approved the use of E10, a blend of 10 percent ethanol and 90 percent unleaded gasoline. Any vehicle requiring unleaded gasoline can operate on E10. Flexible Fuel Vehicles can operate on unleaded gasoline blended with ethanol percentages from zero to 85 percent. A computer in the fuel system of a Flexible Fuel Vehicle automatically adjusts for the level of ethanol in the fuel mix. Currently, a blend of 85 percent ethanol and 15 percent unleaded gasoline is being marketed as E85.



Ethanol Lab
Source: ICM, Inc.



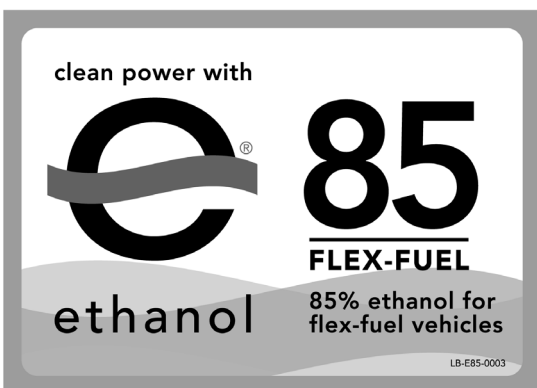
Ethanol Race Car

Credit: Ethanol Promotion and Information Council

In the future, perennial grasses such as switch-grass or forage crops such as sorghum may provide the cellulosic biomass necessary for ethanol production. Ethanol produced from plant materials, or cellulosic biomass, is chemically identical to that produced from

grains such as corn or grain sorghum. However, the carbohydrates found in plant materials (cellulose) are more complex than those found in grains (starch), requiring different processes to break the carbohydrates down into simple sugars that can be fermented into ethanol. Cellulosic biomass includes crops grown specifically for fuel production as well as plant wastes such as wheat straw, sawdust, or paper pulp.

Ethanol benefits the environment because it is made from renewable resources and it reduces exhaust emissions. Ethanol production provides additional markets for Kansas crops and valuable coproducts for agricultural and industrial needs. Research continues to increase the efficiency of the ethanol-making process and explore new opportunities for producing ethanol from other plant-based materials.

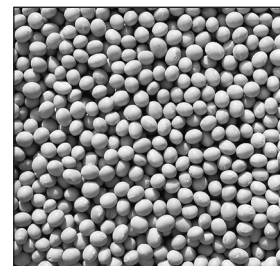


BIODIESEL

In 2004, President George W. Bush signed the first national legislation containing tax incentives for biodiesel production and use. According to the Department of Energy, biodiesel, a renewable fuel for diesel engines that is derived from natural oils like soy oil, has become America's fastest growing alternative fuel. One bushel of soybeans yields 1.5 gallons of biodiesel, according to the American Soybean Association.

To produce biodiesel, soybeans or other oilseeds are processed into vegetable oil. Then, through a chemical process called “transesterification,” the vegetable oil is separated into two products—methyl esters (biodiesel) and glycerin, which is used in soap, lotion, and other products. Biodiesel can be made from vegetable oils, animal fats, or recycled cooking oil. It is a clean-burning fuel that works in any diesel engine or fuel system. It does not contain petroleum but it can be blended with standard diesel fuel. Biodiesel blends, such as B2 (2 percent soybean oil and 98 percent petroleum diesel) and B20 (20 percent soybean oil and 80 percent petroleum diesel) are available in Kansas.

Both production and use of biodiesel is expanding in the United States. The U.S. Navy, the largest user of diesel fuel in the world, uses biodiesel at several naval facilities. The U.S. Coast Guard and the U.S. Postal Service also use biodiesel. City buses, school buses, government vehicles, trucks, and other vehicles run on biodiesel. Many farmers also use biodiesel and soy-based lubricants to produce the next crop of soybeans, completing a cycle of renewable energy.



Soybeans

Credit: Lynn Betts, USDA NRCS



Soy Biodiesel Tour Bus

Credit: Keith Weller, USDA ARS

SEEDS OF SUCCESS

“Look not mournfully into the past. It comes not back again. Wisely improve the present. It is thine. Go forth to meet the shadowy future, without fear.”

Henry Wadsworth Longfellow, American poet

Early explorers did not understand the prairie biome they encountered in the area that became the state of Kansas. They did not understand that the soils supporting the prairie grasslands were some of the most fertile and productive soils in the world. Hardy pioneers and generations of innovative farmers and ranchers built Kansas into a leading agricultural state. Scientists, researchers, industry, and government leaders continue to seek ways to assist farmers and ranchers in maintaining the productivity of the state's cropland.

Today, Kansas farmers grow a variety of crops. These crops are used to create food, feed, fiber, fuel, and industrial and consumer products for people in Kansas, across the United States, and around the world. The productivity of the prairie's soils is no longer in question. ■

Career Profile:**JIM KRUEGER****Assistant State Conservationist, Natural Resources Conservation Service**

Jim Krueger is a man who smiles a lot. His life has focused around the natural resources of the state. Over the years, he has helped agricultural producers and the public learn about the environment and how to conserve, improve, and sustain the land and its resources.

Krueger grew up on a farm in Washington County. When he finished high school, he attended Kansas State University majoring in animal sciences with a minor in agronomy. For 15 years after he graduated, he worked in production agriculture, farming in Washington County. Around 1990, he was encouraged by his wife Peggy to apply for a job with what was then the Soil Conservation Service and is known today as the Natural Resources Conservation Service (NRCS). It appealed to him because of the opportunity to affect the land in a larger sense than just the acres he was farming.

“The vision statement of NRCS is helping people help the land,” Krueger says. “The main focus is to assist landowners as they address everything that affects their land, including all aspects of the environment—soil, water, air, plants, and animals. That had some appeal to me.”

In regards to farmland, Krueger says that what affects the land most is soil erosion, caused by either wind or water, although improved farming techniques have helped decrease all erosion. “Today, specialists focus as much on the soil health and vigor, in addition to erosion,” Krueger says. “We are looking for the presence of organic material and microorganisms and microbiotic activity within the soil. No-till and reduced-till practices will help enhance all of these.”

Although Krueger has worked with NRCS for 20 years, his job description has changed. The one constant has been the necessity to be able to interact with people, including agricultural producers, landowners, and the public.

In the early 1990s, Krueger worked as a district conservationist based out of Abilene. His personality strengths, including the ability to communicate to farmers the importance of utilizing conservation techniques, served him well. In one year, he supervised the building of more than 1.2 million feet of terraces. In addition, Krueger developed a relationship with local media, sharing progressive ideas with the community through news articles and radio programs.

“I was working with producers on a daily basis, helping them solve their problems,” he says. In addition to farmers involved in crop production, Krueger was ready to talk to any kind of livestock producer; he has helped cattle ranchers and hog producers incorporate good waste management practices, and has helped greyhound farmers install pollution controls in their kennels.

When Krueger became a state resource conservationist in 2003, his main job was to work with state specialists to utilize the new technologies available to implement NRCS programs. He also worked with partner groups who helped disseminate information, including universities, technical advisory groups, and other state, local, and federal agencies.

Today, as the assistant state conservationist for operations, Krueger is farther from the agricultural producers, but his work might affect them more. “I work to ensure that each field office has the resources they need to get all the best and newest information out to the producers,” he says. “Those offices are my customers.” Jim is also responsible for operations and administrative management, technical assistance provided to land users through programs for which the NRCS has responsibility, and preparation and maintenance of required records and reports. He serves as a member of the Kansas management team, supervises staff, guides and coordinates the workload analysis and workforce planning process in the state, assists in developing budget estimates, and provides leadership in the Government Performance Review Act in Kansas.

Krueger says that the main thing that has remained constant during his tenure with NRCS is the agency’s commitment to the land and landowner. “If you can work with people and listen to their concerns and their problems, if you have some common sense, you’ll do well,” he says. “That is what everyone needs.”



Credit: USDA NRCS

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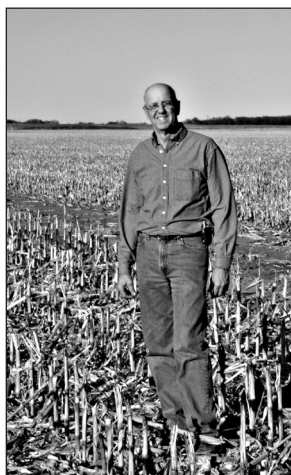
Career Profile:**MARK TADDIKEN****Agricultural Producer and State Senator**

Mark Taddiken, a farmer from Clifton, was first elected to the Kansas Senate in 2000. As a state senator, Taddiken's job is to look out for the best interests of Kansas; when he is farming, his job is to care for the land and his family. Taddiken spends 90 days out of the year representing eight rural counties in Kansas. He deals with a wide variety of issues during each legislative session, just as he enjoys a variety of agricultural activities and challenges while farming.

When the state legislature is not in session, Taddiken loves running the farm. "This is where my heart is. I love being outdoors and working with the land to provide food for others," Taddiken says. His family farms the same land that his great-grandfather did when he settled near Clifton 130 years ago. Taddiken believes that his background as a farmer helps him do his job better as a state legislator. Since Taddiken represents rural counties, his agricultural background helps him understand the challenges faced by many of the people who live in his district. "Agriculture is the number one industry in Kansas and many issues that come before the senate have ties to agriculture. Many of the natural resource and agricultural issues affect each other." Renewable energy topics, such as ethanol, biodiesel, and wind energy, are among recent legislative topics. Taddiken, other legislators, and their staffs research and discuss issues before deciding which legislation or actions to pursue.

Taddiken believes that being a farmer has helped him understand statewide concerns such as balancing the state's budget. "A farmer realizes that if there is money, one cannot just go and spend it; one needs to think about the future," Taddiken says. Agriculture has changed drastically since Taddiken started farming. There is more information to sort through and new technologies are available. "To run a farm these days, a farmer must be educated—whether that be formal education, on-the-job training, or just keeping current on changes in the industry." Taddiken thinks that keeping updated on agricultural industry topics helps him be a better representative of the people in his district.

Taddiken is not afraid to ask questions that will help him understand other viewpoints. A well-rounded perspective enables him to empathize with his constituents. "My job as a senator is to make Kansas a better place to live," Taddiken says.



Credit: Trent Winter

Cropland Showcase:**HARNEY SILT LOAM**

Kansas became the seventh state in the United States to adopt an official soil when Harney silt loam was adopted as the Kansas State Soil on April 12, 1990.

Kansas has more acres of prairie soils than any other state and over 300 different soil types. Due to the state's unique soil legacy and the completion of the state's most comprehensive soil inventory by the USDA Natural Resources Conservation Service, it was proposed that a typical prairie soil be selected to serve as the state soil. It took five years and a strong grassroots effort before legislation was passed naming Harney silt loam as the Kansas State Soil. This soil serves as a standard against which other soils in the state can be compared.

Harney silt loam possesses the ideal qualities of a prairie soil and it is the most extensive soil in the state, covering almost four million acres in 26 west-central Kansas counties. A variety of crops, irrigated and dryland, are produced on Harney silt loam.

Harney silt loam is a very deep well-drained soil formed by wind-blown silt called "loess." This soil typically has a dark grayish-brown topsoil layer about 12 inches deep. Below this lies the subsoil layer that is about 23 inches thick and is a mixture of silt and clay. The upper part of the subsoil layer is grayish-brown in color while the lower part is brown. The parent (lowest) layer of the soil is 35 to 70 inches deep, yellowish-brown in color, and contains a few chalky sediments.



Credit: USDA NRCS

Cropland Showcase:**KSU AGRICULTURAL RESEARCH CENTER—HAYS**

Famous names, including those of General George Armstrong Custer and Buffalo Bill (William F. Cody), add color to the history of the KSU Agricultural Research Center in Hays—once part of the Fort Hays military reservation. Deactivated in 1889, Fort Hays was transferred to the state of Kansas in 1900. A resolution signed by President McKinley set aside 4,160 acres for a state institution of learning at Hays, 3,263 acres for an agricultural experiment station and 177 acres for a state park.

Established in 1901, the Fort Hays Branch Experiment Station began conducting research appropriate to western Kansas where rainfall is more limited. Early research focused on improving wheat and grain sorghum varieties and included irrigation and soil conservation studies, tree nurseries, and livestock research. In the 1940s, scientists at the Station expanded the range management research—focusing on grazing intensities, improved grass varieties, range reseeding, grass fertilization and weed control. Rangeland research conducted by scientists at the Hays Station resulted in new management practices specifically for native shortgrass prairies and pastures.

Scientists at Hays were among the first to test and demonstrate the advantages of crossbreeding cattle. The entomology and beef cattle research programs at Hays cooperatively developed insecticide-impregnated ear tags for fly control. Researchers at Hays pioneered conservation tillage practices using chemical weed control and today, reduced tillage practices are common throughout the Midwest.

In 1994, legislation changed the name to KSU Agricultural Research Center—Hays (ARCH). The Center, which owns 7,345 acres and leases another 465 acres, includes over 2,400 acres of cropland and 5,120 acres of rangeland.

Current research programs focus on beef cattle production, crop production, pests (weeds, insects, and diseases) associated with most of the major crops grown in Kansas, the genetic improvement of specific crops, and rangeland management. Using new technologies, scientists at the KSU Agricultural Research Center—Hays are engaged in cooperative research projects with scientists around the world. Those research projects—rather than colorful names from the history books—continue to bring international recognition to KSU Agricultural Research Center—Hays.



Credit: KSU Agricultural Research Center—Hays

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Kansas Association of Conservation Districts

<http://www.kacdnet.org/>

KSU Agricultural Research Center–Hays

<http://www.wkarc.org/Arch/arch.asp>

International Plant Nutrition Institute

www.ipni.net

Soil Biology Primer

USDA NRCS

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State Soils

USDA NRCS

http://soils.usda.gov/gallery/state_soils/

Stewardship Week educational materials

National Association of Conservation Districts

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25 x '25 Alliance

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Wessels Living History Farm

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