Unit 2) Soil: The Earth's Living Skin

That was Then and This is Now...

Then

"Many think that the 'dirty thirties' was the first time dirt ever blew to speak of. The very dry year of 1911 was followed by the big, dry snow on December 20 of that year, which had practically no moisture in it. With the weather so cold, most of what moisture it did contain froze out of it, and when it melted in the spring, the topsoil was in ideal condition to blow...

Now, two generations later, we find ourselves in the same conditions...

We became desperate. We had survived the winter of 1934-35, but spring came with no relief in sight, while we watched continuously for promising clouds to the northwest. We would hope and pray for rain, but when clouds rolled over us, it would only be another duster, and we could hardly breathe." [1]

John K. Glanville, 1935

Now

"It has been 75 years since 'Black Sunday,' one of the worst dust storms of the 1930s. Lessons have been learned and farming practices have changed. Today soil erosion has been reduced with no-till farming and the establishment of windbreaks, terraces, waterways, wetlands, ponds, buffer strips, and crop rotations. The NRCS National Resource Inventory report showed that soil erosion on U.S. cropland decreased 43 percent between 1982 and 2007. Erosion due to wind declined by 765 million tons a year.

Today sediment loading is a concern in the storage capacity of the State's water supply reservoirs. The City of Horton and the Kansas Clean Drinking Water Fee fund (administered by the State Conservation Commission) have provided funding for the first dredging project in Kansas at Mission Lake. Water quality is also a concern with KDHE establishing TMDLs for the state's water bodies. The soil survey is now on the web, useful in determining if land is highly erodible.

Rains continue in the months of May and June, delaying planting with flooding in low areas. The forecast is clear skies for the next few days. It's time to put up brome hay."

Roberta Spencer, June 2010

Soil is the naturally occurring mixture of minerals, organic matter, water, and air – all of which combine to form the surface of the Earth. Soils are among the most complex materials on the planet and serve as the interface between the Earth's solid outer layer (crust and mantle), the Earth's water-covered portion, and the atmosphere.

Planet Earth
Source: Image Science & Analysis Laboratory, Johnson Space Center

Soil
Credit: Jana Lindley, No-till on the Plains

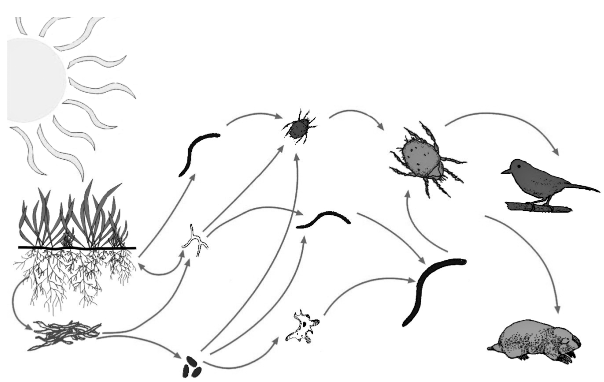
Soil Functions

Typically, soil is thought of as the material that supports and nourishes growing plants. This is true as soil anchors the roots of plants and stores water and nutrients long enough for the plants to make use of them. However, soil's importance goes far beyond just supporting plant life. By decomposing organic matter, organisms living in the soil convert nutrients into different forms, making those nutrients available to plants and other organisms. According to the National Soil Survey Center of the USDA Natural Resources Conservation Service, this means that a single spade full of rich soil can contain more species of organisms than can be found in the entire Amazon rain forest! In fact, the International Union of Soil Sciences refers to soil as the "Earth's living skin," saying that the majority of the Earth's diversity is in the soil, not above ground. [2]

In addition to contributing to agricultural productivity, soil affects other natural resources, including air and water. Soil has four major functions:

1. 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.
2. Protecting the quality of water, air, and other resources by filtering, buffering, degrading, and detoxifying potential pollutants.
3. Regulating the distribution and storage of water and other nutrients, including compounds dissolved in the water.
4. Storing and cycling plant nutrients and other elements.

Soil Food Web



Source: USDA NRCS

Organisms living in the soil feed on carbon stored in plant roots and other decaying organic materials. The soil food web builds as predators feed on organisms that specialize in decomposing materials. Other predators then consume those predators. At each level of consumption, waste and organic materials are deposited in the soil, where they begin to decay.

Soils also provide support for structures like buildings, roads, and highways. In fact, the characteristics of soils often determine which lands are used for growing crops, for pasturing animals, as recreational areas and parks, for waste disposal systems, and for other miscellaneous uses.

Building Construction
Credit: Lynn Betts, USDA NRCS

Soil Formation

Soil is considered a nonrenewable resource because it takes between 100 to 600 years or more to "grow" an inch of topsoil – the most productive soil layer. Five factors contribute to the formation of soil: bedrock, climate, topography, living organisms, and time.

Soil Formation Words
Bedrock – a solid rock layer at or near the Earth's surface.
Climate – the average weather conditions of a given point during a given set of dates, including the average rainfall, temperature, humidity, and wind conditions.
Decomposition – the biological process of breaking down complex molecules in dead organic materials into simpler molecules.
Microorganism – any organism too small to be seen without a microscope.
Organism – any living thing capable of growth and reproduction, such as a plant, animal, fungus, or bacteria.
Topography – the features on the surface of an area of land, including natural features like mountains or rivers and manmade features like roads.
Weathering – the process of breaking rock and mineral particles into smaller particles.

Bedrock

Bedrock lies beneath the deepest layer of soil, the layer known as the parent material. When bedrock is exposed to water, air, and other elements over a long period of time, weathering takes places. Weathering refers to the process of breaking down rock and mineral particles into smaller particles. Typically, the smaller particles move and form new soils where they are deposited by wind or water.

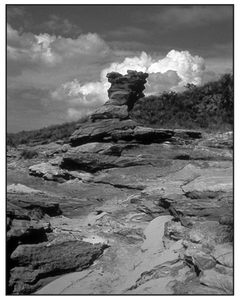
Red Hills, Clark County
Credit: John Charlton, KGS

Climate

Climate also affects how quickly soil forms. Climate refers to average weather conditions such as rainfall, temperature, humidity, and wind speed. Temperatures affect how rainfall and other forms of precipitation speed up – or slow down – the weathering process. For example, under freezing temperatures, water that seeps into openings in a rock will expand and crack the rock, exposing even more rock surface to the weathering process or breaking the rock into smaller pieces. Temperature and moisture conditions also affect the movement of particles. When it is extremely dry, the wind is able to pick up and move particles that it cannot move when the conditions are wet or humid. The interaction of the weather conditions influences soil formation.

Topography

The topography of the land dictates how quickly soil may be formed. The slope of the land influences the physical weathering of bedrock. Steep slopes erode faster when water and wind move quickly across the land's surface, also speeding up the physical weathering of bedrock. Particles moved by the erosion are deposited on other more level surfaces, resulting in deeper soil layers in those areas.



Marion County
Credit: John Charlton, KGS

Living Organisms

Plants, animals, people, and microorganisms all contribute to the formation of new soils. People and animals mix the soil layers when they dig in the soil and move it from one place to another. Plant roots and organisms living in the soil, such as earthworms, open up channels in the soil for water, air, and nutrient movement. Microorganisms living in the soil feed on carbon stored by plant roots and other decaying organic materials. These microorganisms excrete materials that hold soil particles together, improve the soil's ability to hold water, create pathways for water and nutrients to move through the soil, and provide nutrients for growing plants and other organisms.

Moving Soil
Credit: Larry Rana, USDA

Time

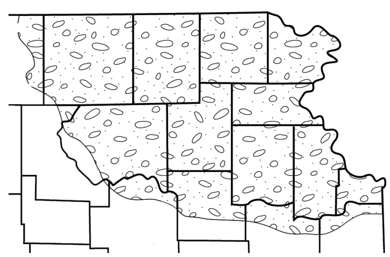
All the soil-forming factors interact over time, either speeding up or slowing down the continuous process of soil formation. During a flood, fast-moving water could quickly move particles from one place to another much farther downstream. On the other hand, gentle rainfall may have little to no impact on exposed bedrock. Soil changes may be slow or rapid, depending on the interaction between the bedrock, climate, topography, and living organisms.

Soil Movement

Soil can be a mixture of materials transported and deposited by water, wind, or glaciers.

Kansas soils, particularly in the western and central regions of Kansas, resulted from the formation of the Rocky Mountains about 70 to 40 million years ago. At first, thick layers of sedimentary rock covered the uplifted mountains. Millions of years of erosion at work on the Rocky Mountains to the west have deposited layers of sediment across Kansas. Eastward flowing streams carried rocks, sand, gravel, and silt off the mountains and deposited the materials into stream valleys and other areas in the High Plains region of Kansas (the western one-third of the state).

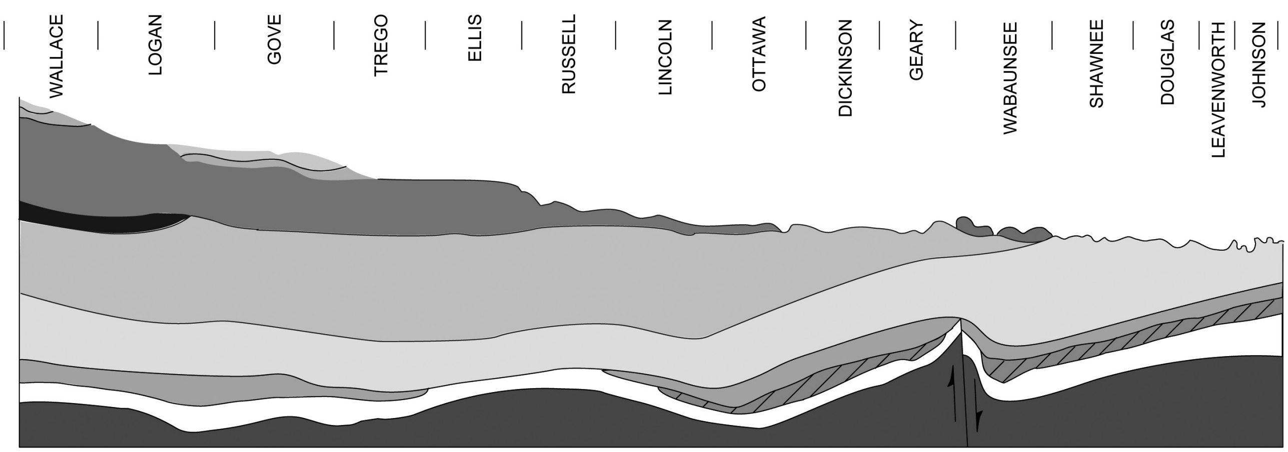
Glaciers also affected soil formation in Kansas. According to the Kansas Geological Survey, at least two glaciers covered northeastern Kansas. Loess (pronounced "lus") is windblown silt, carried after mud hardens and turns to dust. After the first glacier, the wind left thick loess deposits in the western portion of the state – deposits that were later covered by the sediments deposited following the formation of the Rocky Mountains. One result of these activities is the gradual shift in elevation across Kansas, from the highest point in Wallace County near the western border (4,039 feet above sea level) to the lowest point in Montgomery County near the southeastern border (679 feet above sea level).



Glaciated Region of Kansas
Source: Kansas Geological Survey

The most recent glacier that entered Kansas occurred approximately 600,000 years ago, extending almost as far west as Manhattan and south beyond Topeka and Lawrence. [3] The sheet of ice, which was nearly 500 feet thick in places, ground rocks into fine

Geological Cross Section of Kansas (West to East along I-70)



Source: Kansas Geological Survey

sediment as it moved across the North American landscape. As the ice melted, the water formed streams that carried the sediments away and deposited those in other places. This time, the thickest glacial loess deposits occurred in northeast Kansas.

Soil Composition

Soil is a mixture of inorganic and organic components. Generally, organic components are derived from living organisms, such as plant or animal material. In contrast, inorganic components, including minerals, air, and water, are composed of matter that is neither animal nor plant based.

Organic vs. Inorganic
Organic matter – any material that is part of or originated from living organisms; breaks down through decomposition.
Inorganic matter – matter that is mineral-based, rather than originating from animal or plant sources; disintegrates through weathering.
Mineral – a natural compound with a definite chemical structure and formula that has formed through geological processes.

Organic Matter

Organic matter is an essential component of soil. Examples of organic materials include plant residues (grass, leaves, fruit, or vegetable scraps) and animal materials and waste. Soil contains living organisms that decompose organic materials, turning them into organic matter and recycling the organic materials as nutrients, which are made available for use by living plants and animals.

Compost is a specific type of organic material. Compost is defined as a mixture of organic materials in various stages of decay. Nearly any plant or animal material can be composted, but different materials may take varying amounts of time to decay. Agricultural producers employ techniques similar to composting, just on a much larger scale than individuals might use. Crop residues, such as plant stalks and roots, increase the organic matter in the soil when left to decay in the field. When necessary, other organic materials, like animal waste, may be incorporated into the soil to enhance the physical and chemical properties of the soil.

Compost
Credit: Larry Rana, USDA

Crop Residue
Credit: Jeff Vanuga, USDA NRCS

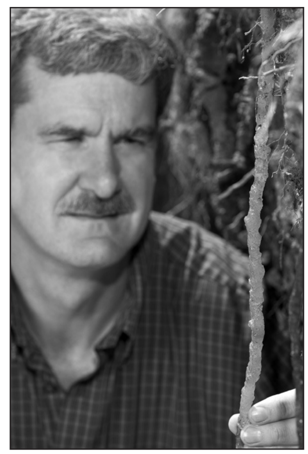
Soil Close-up
Credit: Jana Lindley, No-till on the Plains

Inorganic Matter

Minerals and organic particles make up about 50 percent of the volume of soil. Small spaces between the mineral and organic particles, known as capillaries, account for the remaining volume. These capillaries transfer and hold water in the soil and allow oxygen and other gases to move through the soil. This permits plant roots and small animals, such as insects or earthworms, to move through the soil to collect water and nutrients. Air and water also speed up the decomposition process by increasing the activity of bacteria, amoeba, fungi, and other microorganisms.

Earthworms

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 (also known as worm castings), nutrients are deposited in the lining of tunnels created by their burrowing activity. Worm castings also contain microorganisms that convert nutrients into forms that can be used by plants.



Replica of Earthworm Tunnel
Credit: Peggy Greb, USDA ARS

The tunneling activity of earthworms creates openings for water and air to move through the soil and establishes 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.

Classifying Soils

Soils are classified just like plants and animals. No two types of soil are exactly alike, but similar soils are grouped together in a system of soil classification known as soil taxonomy. In fact, the National Cooperative Soil Survey program has been mapping the soils of the United States for more than 100 years.

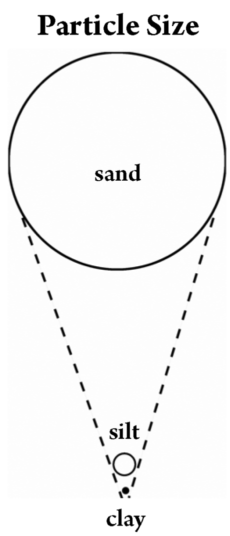
The National Cooperative Soil Survey program has established a system of identification that divides all the soils in the United States into 12 soil orders, which is the highest level of soil classification. Each of the soil orders is then subdivided several times, resulting in about 18,000 different soil types. While the soil type will never change, the way the soil is managed can influence the health (productivity) of the soil. Each of these soil types has distinct properties, including texture and color.

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.

Soil Texture



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

Source: KFAC

The mineral particles that make up soil are sand, silt, and clay. The largest of the three sizes of particles are sand particles, which can be seen without magnification. Silt particles feel like a smooth powder, much like wheat flour or baby powder, but require magnification to be seen. Clay particles feel sticky, almost like plastic, when wet but feel hard and rough when dry. Smaller than silt particles, clay particles require an electron microscope to be seen.

Soil textures are determined by the percentages of sand, silt, and clay in the soil mixture. For example, clay soils are fine and sticky, while silty soils are smooth but crumble when wet. In contrast, sandy soils are gritty and abrasive whether wet or dry.

All soils need some clay particles to hold moisture in the soil. In contrast, sand particles help soil from becoming too compacted or solid. Silt particles are light and easily moved around by plant roots, water, air, and microorganisms, but that also makes those particles more prone to wind and water erosion. Loam soil types contain equal amounts of sand, silt, and clay particles.

Soil Texture

Credit: Jeff Vanuga, USDA NRCS

Soil Color

Color is an indicator of soil properties and helps identify different soil layers. Generally, the color of a soil becomes darker as the amount of organic matter in the soil increases.

Soil Color

Credit: Lynn Betts, USDA NRCS

Kansas Soils

Of the 12 soil orders used to classify soils in the United States, mollisols are the predominant soil order of the Kansas croplands. Mollisols are naturally fertile and can hold large amounts of water. They have a very distinct dark color and are enriched with organic matter. These soils are capable of producing abundant agricultural crops.

Of the nearly 18,000 soil types found in the United States, more than 300 different soil types have been identified and mapped in the state of Kansas.

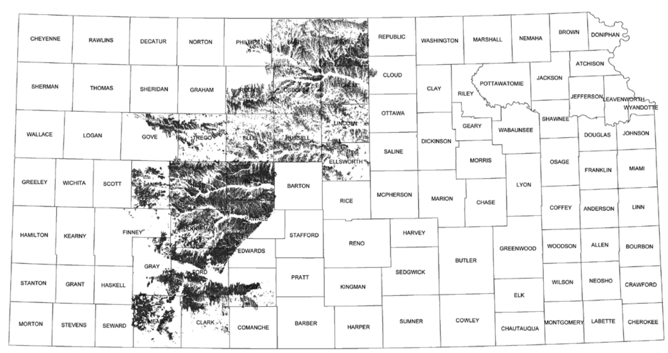
Harney silt loam is the most widespread soil type in Kansas, covering almost 4 million acres in 26 counties. In 1990, the state of Kansas adopted Harney silt loam as the Kansas State Soil.

Harney Silt Loam

Every state has an official state soil. In 1990, Kansas adopted Harney silt loam as the Kansas State Soil. Harney silt loam is the most wide-spread soil type in Kansas, covering almost four million acres in 26 counties.

The desirable qualities of Harney silt loam make it an ideal prairie soil. Formed by wind-blown silt called "loess," this is a very deep, well-drained soil. It typically has a dark grayish-brown topsoil layer about 12 inches deep. Below this lies the subsoil layer, which is a brown mixture of silt and clay about 23 inches thick. The layer of parent material is 35 to 70 inches deep, yellowish-brown in color, and contains a few chalky sediments.

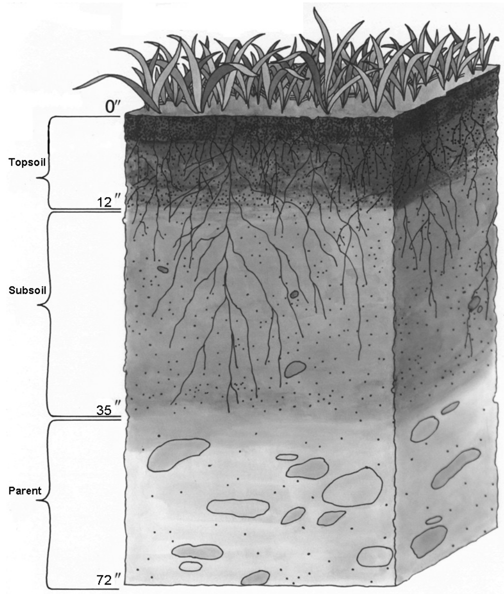
Harney Silt Loam in Kansas



Source: USDA NRCS

Soil Layers

A soil is usually made up of three layers called horizons. The thickness and qualities of each layer will vary depending on location. Changes in color or texture help visually define the different layers, with the lines between the layers often appearing to be parallel to the Earth's surface. Overall, soils range in depth from just a few inches to



Soil Profile
Source: USDA NRCS

many feet. Farmers, scientists, and engineers retrieve a soil profile, also known as a sample of the various layers, by probing or drilling into the soil.

Parent Material

Parent material is the deepest layer of soil. It is a layer of unconsolidated rock, gravel, and large particles covering the solid layer of rock known as bedrock.

Subsoil

The subsoil layer covers the parent material. The subsoil contains finer particles than found in the layer of parent material. The subsoil layer also includes some organic matter but not nearly as much organic matter as found in the topsoil, the top layer of soil. Deep-rooted plants such as sunflowers and soybeans can penetrate deep enough to retrieve moisture and nutrients from the subsoil layer.

Topsoil

Topsoil is the uppermost and most productive soil layer. Farmers plant their crops in this layer of soil. Plants with branching root systems, such as wheat, grain sorghum, and corn, depend on the topsoil for moisture and nutrients.

Topsoil is the soil layer most impacted by conditions on the Earth's surface as soil particles can erode, becoming detached and moving with water, wind, ice, or gravity. When erosion occurs, the detached particles carry away nutrients needed by plants. As long as the topsoil and subsoil layers are present, the layer of parent material and the bedrock are less likely to experience changes than the topsoil and subsoil layers. However, in some mountainous or rocky areas of the world, bedrock is exposed and directly affected by surface conditions.

Exposed Bedrock
Credit: John Charlton, KGS

The Great Plains

The Great Plains is a major ecological region found in the central part of the continent of North America, occupying nearly 1.4 million square miles. This area extends from the Canadian provinces of Alberta, Saskatchewan, and Manitoba south into northeastern Mexico and from western Indiana to the foothills of the Rocky Mountains. Approximately 34 million people live in the Great Plains, including 32 million in the U.S. portion of the region.

Across the Great Plains, rainfall decreases from east to west–defining different types of native prairies. While there are grassland and forest combinations along the eastern edges of the Great Plains, few native trees occur across other areas of the region. The Great Plains is one of the largest farming and ranching regions of the world and agriculture is the most important economic activity of the Great Plains.

The entire state of Kansas falls within the Great Plains ecological region. However, in Kansas, many people refer to the western two-thirds of the state as the "Great Plains."

Soil Conservation

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 increased. Eventually, adventurous settlers from the eastern regions of the United States sought new opportunities in the west. However, they crossed over the prairie grasslands in the center of the United States in search of more productive lands. The Plains states were among the last areas settled in the United States. After the Plains states were homesteaded, there were very few opportunities left to claim "new" land in the United States.

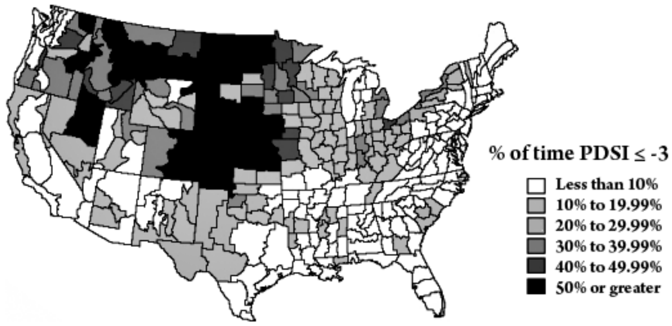
The Dust Bowl

In the United States, protecting soil resources and preventing soil erosion became national goals as a result of the "Dust Bowl." In the 1930s, a widespread severe drought affected the entire country. Although dust storms started affecting the Plains states as early as

Soil Drifts around Barn, Liberal, March 1936
Source: Library of Congress; Arthur Rothstein, photographer

Palmer Drought Severity Index 1934–1939

Percent of Time in Severe and Extreme Drought



Source: National Drought Mitigation Center

1932, the eight years from 1933 to 1940 are known as the drought years of the Dust Bowl period. The driest region included the southwest area of Kansas, southeastern Colorado, and the panhandles of Texas and Oklahoma.

In 1934, more than 80 percent of the entire country experienced extremely dry conditions. A 1934 report estimated that "35 million acres had been completely destroyed in terms of usefulness for farming, the topsoil had been largely or completely removed from an additional 125 million acres, and that another 100 million acres were suffering lesser but increasing damage." [4] During the Dust Bowl, the windstorms blew red-colored soil from Oklahoma as far north as Canada and as far east as the Atlantic Ocean. 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.

On April 27, 1935, a major dust storm blew into Washington, D.C., helping persuade the U.S. Congress to adopt proactive soil conservation measures. That day, Congress passed legislation that became the basis for all national soil and water conservation programs, including those still in place today. Public Law 46, "the Soil Conservation Act of 1935," established the Soil Conservation Service in the U.S. Department of Agriculture. Hugh H. Bennett had been testifying before Congress at the time the dust storm blackened the skies of Washington, D.C. Bennett became the first chief of the Soil Conservation Service, which was reorganized as the Natural Resources Conservation Service in 1994.

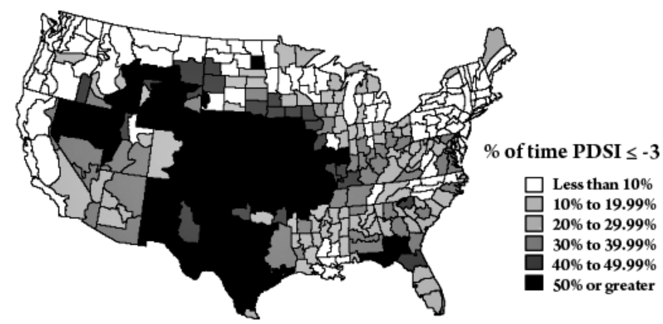
Dust Storm
Source: USDA NRCS

Although the future of agriculture in Kansas and other Plains states looked bleak in the 1930s, Kansas farmers addressed soil and water conservation issues with the assistance of the Soil Conservation Service and other county, state, and national agencies. The work continues today as many of the same agencies continue to partner with farmers and landowners. These partnerships provide technical knowledge, financial assistance, and leadership for conservation activities that assist farmers and landowners in conserving, maintaining, and improving soil and other natural resources.

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 continue to increase food production to meet the needs of the expanding population in the United States while supplying agricultural exports and food aid for the rising worldwide population.

Palmer Drought Severity Index 1954–1956

Percent of Time in Severe and Extreme Drought



Source: National Drought Mitigation Center

Conservation Practices

Agricultural producers maintain the productivity of the land by using appropriate soil and water conservation measures. 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 patterns. The goal of these practices is to keep the soil in place and the water on the land where it falls. A common conservation practice, contour farming, refers to farming back and forth across the slope of the land, rather than farming up and down the field from higher to lower areas.

Many conservation practices also reduce the degree of wind erosion. Under certain conditions, soil particles can start blowing when wind speeds exceed 12 miles per hour. [5] In areas where soils are vulnerable to wind erosion, agricultural producers use additional conservation

Contour Farming
Credit: Jeff Vanuga, USDA NRCS

Strip Cropping Corn
Credit: Gene Alexander, USDA

Kansas Terraces
Credit: Jeff Vanuga, USDA NRCS

Grassed Waterways
Credit: Tim McCabe, USDA

Buffer Strip
Credit: Roberta Spencer

measures, such as planting crops at an angle to the prevailing winds or alternating wide strips of growing crops with strips of residue from previous crops. Strip cropping involves alternating strips of growing crops throughout a field to prevent wind or water erosion.

Landowners and agricultural producers also install terraces and grassed waterways on cropland to prevent soil and water erosion. Terraces – raised, generally horizontal ridges of earth embankments – are constructed following the contour of the land. Shallow channels on the uphill side of a terrace capture water and slow it down while directing the water into slower moving channels, such as grassed waterways or outlets. Grassed waterways are broad shallow channels planted to grass. The grass provides cover for the soil and the soil stays intact when there is water runoff.

Natural or planted strips of vegetation such as buffer strips, filter strips, and field borders also protect soil water quality. Like grassed waterways, these strips of vegetation slow water down and trap soil particles before they can enter a stream, river, pond, or lake.

Crop Production

Crop production may involve any combination of cropping practices and tillage operations. Two of the common cropping practices in Kansas are crop rotation and summer fallow (ecofallow). Crop rotation refers to growing a planned sequence of crops in comparison to continuously growing only one crop on the same area of land. Summer fallow requires leaving the land idle during at least one growing season to accumulate moisture in the soil for the next crop.

Crop Rotation
Credit: Tim McCabe, USDA NRCS

Tillage

At one time, most tillage methods consisted of breaking up the soil, pulverizing any large clods or clumps of plant material, and leveling out the soil to create a smooth, finely-ground seedbed. Today, Kansas farmers use a variety of tillage methods designed to create rough surfaces, increase the water storage capacity of the subsoil, and leave part or all of the residue from previous crops on or near the surface of the soil.

Generally, farmers choose the least amount of tillage necessary to meet crop production requirements for yield production goals. They decide which tillage methods to use based on a number of factors, including the crops that are being grown, the existing soil and climatic conditions, and economic factors such as fuel costs.

Conservation Tillage
Credit: Lynn Betts, USDA NRCS

No-till Farming

Many farmers practice no-till farming, where no mechanical manipulation of the soil takes place between the harvest of one crop and the planting of the next. The undisturbed crop residue from each crop helps hold the soil in place while it decomposes and adds organic matter to the soil. The crop residue also traps precipitation and protects the soil from drying winds. Typically, crop protection products such as herbicides are applied to weeds and other undesirable plants when those plants are small. This also conserves soil moisture for future crops, prevents competition for water and other nutrients, and protects future crops from insects and insect-borne diseases. Across Kansas, farmers have reduced tillage and embraced no-till farming as a result of scientific research, expanded access to information and products, and improvements in technology and agricultural products.

No-till Soybeans in Wheat Residue
Credit: Gene Alexander, USDA

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 monitoring by a human operator 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.

2004 Tsunami Impact on Soils

The 2004 tsunami in the Indian Ocean affected farmland in many countries. The seawater contaminated groundwater aquifers with salt and increased salt levels in soils to the point where crops could not grow. In some places, all the topsoil was washed out to sea, while, in other places, cropland was covered with clay and silt sediments left behind by the tsunami waves. Removing the sediments was impractical, so changes in farming methods and agricultural crops had to be made. The tsunami also washed away or destroyed agricultural workers, agricultural equipment, and seed for future crops. It left behind debris that had to be removed before the land could be planted to crops again.

In Indonesia, the U.N. Food and Agriculture Organization estimated as many as 92,000 farms and small enterprises were partially or wholly destroyed by the 2004 tsunami. [8]

Precision Agriculture

Precision agriculture incorporates technologies using computers, satellite-based positioning and information systems, automatic guidance systems (autosteering), yield monitors, remote sensors, and other new applications. These farming technologies improve the accuracy of machinery operations and allow farmers to vary inputs (seeds, nutrients, water, and crop protection products) according to the needs of the plants at site-specific locations within a larger crop field.

Precision Agriculture
Credit: Bob Nichols, USDA NRCS

Soils For The Future

The study of soils, known as pedology, contributes to increases in agricultural production that feed, clothe, and house much of the world's population. At the same time, increased knowledge of the science of soils allows decision-makers to anticipate problems, manage natural resources, and implement solutions that mitigate problems, such as those resulting from the contamination and loss of productive soils due to the Indian Ocean tsunami in 2004.

Even though soils develop very slowly, they hold the key to our future. The United Nations International Fund for Agricultural Development predicts that food production will need to increase by 50 percent by 2030 to meet the demands of the world's population, projected to be more than 8 billion by then. [6] David Montgomery, University of Washington geologist, puts it this way, "With eight billion people, we're going to have to start getting interested in soil. We're simply not going to be able to keep treating it like dirt." [7]

Source: Keith Weller, USDA ARS

World Food Production Fact

According to the U.N. International Fund for Agricultural Development, by 2030, food production will need to increase by 50 percent to meet the demands of the world's population, which is projected to be more than 8 billion at that time.

Endnotes

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4. R. Neil Sampson, *For Love of the Land: A History of the National Association of Conservation Districts* (League City, TX: National Association of Conservation Districts, 1985), p. 6.

5. James H. Strine. *Windbreaks for Kansas*, Kansas State University, May 2004, p. 4, http://www.ksre.ksu.edu/library/FORST2/MF2120.pdf.

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8. "Indonesia Post-Tsunami Consolidated Assessment," Food and Agriculture Organization of the United Nations, April 22, 2005, http://www.fao.org/ag/tsunami/assessment/indonesia-assess.html.

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Teacher's Resources

The Kansas Foundation for Agriculture in the Classroom (KFAC) offers lesson plans and other educational resources on the KFAC website: **www.ksagclassroom.org**.

Notes: