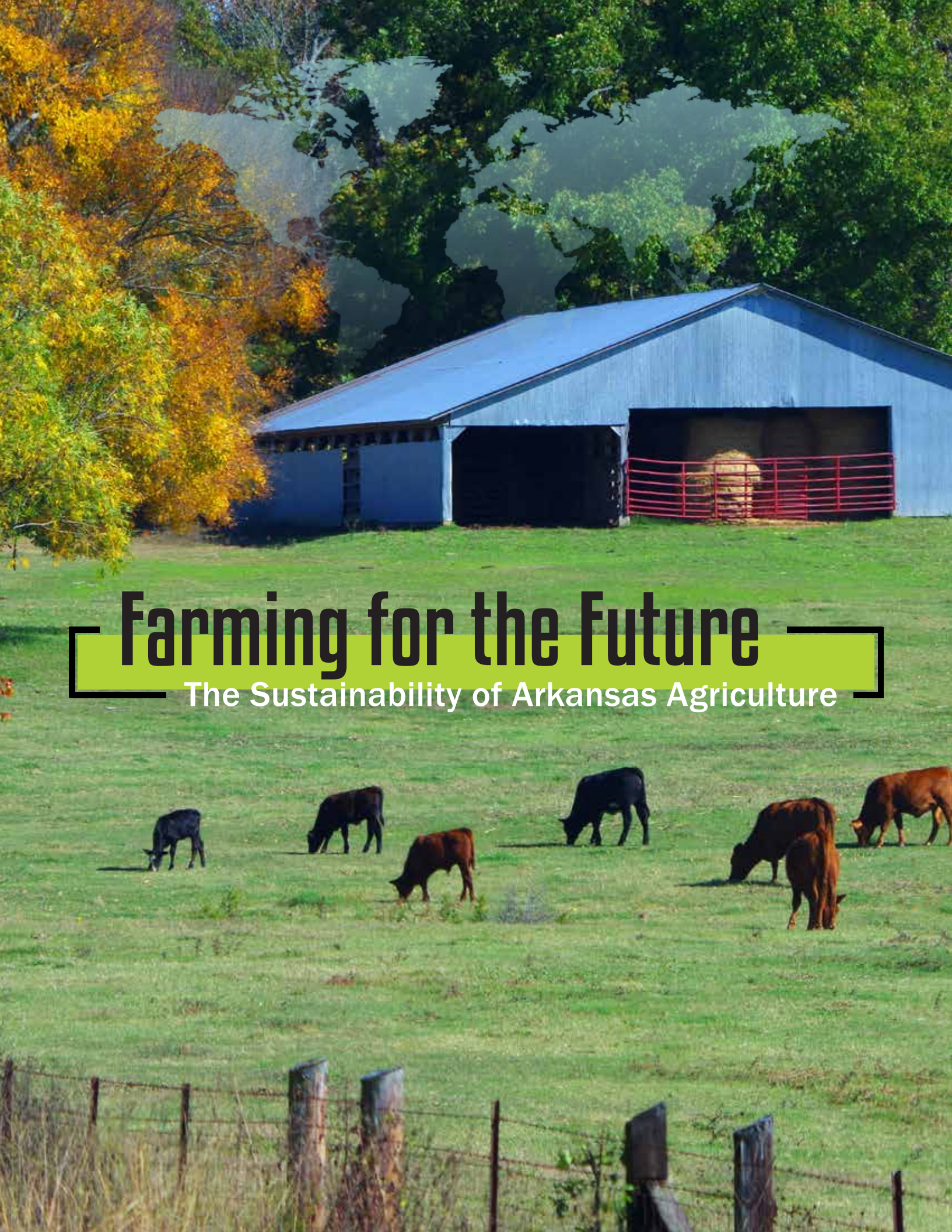


Farming for the Future

The Sustainability of Arkansas Agriculture

Sustainability - An integrated system of plant and/or animal production having a site-specific application that will, long term, satisfy human food and fiber needs.

Agriculture is evolving to sustain the needs of a constantly growing world population. Farmers voluntarily address these concerns as a long term investment in the future. This publication focuses on the steps farmers are taking to continue sustaining the agriculture industry, as well as how they can engage in some of these initiatives. The impact of today's efforts will have a direct effect on tomorrow's families for generations to come.

The purpose of agricultural sustainability is to enhance the quality of life for farmers and society as a whole. As the world population is predicted to rise to 9 billion people by 2050, we must continue to be strategic in our efforts to preserve and care for our resources. While the available farm land decreases, the importance of sustainability efforts increases. The challenge is to remain sustainable, improve and produce more, while continuing to preserve the environment, enhance public health and maintain the quality of care of food animals. These things are essential to continue sustainable agricultural practices that will support future generations.

Arkansas farmers are active partners in growing a sustainable food supply and increasing yields while using fewer inputs and less available land.

1840
First refrigerated rail car for transporting seafood and dairy products

1850
First cattle drive from Texas to California

1870s
First cattle vaccines are made

1919
The term "biotechnology" coined by Karl Ereky

1935
Massey-Harris builds first self-propelled combine harvester

10,000 years ago, humans began crop domestication using selective breeding

Louis Pasteur invents process known as pasteurization

Tractor use outpaces draft animals for the first time

1700s
Farmers and scientists began cross breeding plants for desired traits

1831
McCormick invents mechanical reaper

1835
Hiram Moore invents combine harvester

John Deere invents steel plow

1865
Mendel develops the laws of heredity

Railroad transport of agricultural goods now moves cross-country, ending the great cattle drives

1870
American horticulturalist, Luther Burbank, the father of modern plant breeding, develops more than 800 new strains of fruits, vegetables and flowers

Beginning of modern large-scale poultry farming

1930s
Artificial Insemination is used in dairy cattle

1837 **1864** **1880s** **1921** **1940s**

1947
International Harvester builds first commercial mechanical cotton picker

1951
Transplantation or "jumping genes" discovered in corn

1993
The FDA approves recombinant bovine somatotropin (rBST) for increased milk production in dairy

1994
Calgene's FlavrSavr® tomato becomes the first genetically-modified food to be approved for sale and human consumption by the FDA

1995
The first genetically engineered potato, resistant to the Colorado potato beetle, is sold in Canada

2000s
Introduction of computer-controlled climates to poultry houses

Golden rice developed. Golden rice is a genetically modified variety of rice containing large amounts of the orange or red plant pigment betacarotene, a substance important in the human diet as a precursor of vitamin A

FDA Approves First GMO

1982 | 1996 | 1999 | 2012

1994
GMO hits grocery stores

Farmers worldwide grow more than 420 million acres of biotech crops

1990s
First GMO crops are introduced into the marketplace

1980s
Cattle EPDs collected and calculated data to improve selective breeding

Biotech crops are grown commercially on nearly 5 million acres worldwide, mostly in the United States, Argentina, Canada, Australia, China and Mexico

1950s
Start of 30-year effort to eradicate the screw worm from livestock in U.S.

1990s
Introduction of yield mapping and variable rate applications using GPS

1999
GPS-guided auto-steer tractors hit the market

Arkansas ranks **9th** out of **50 states** in money spent on conservation, with Arkansas farmers and the public spending $438 million.

Conservation

Conservation is the protection of resources from loss, damage or neglect.

Conservation is a vital component to sustainability. Arkansas farmers have voluntarily engaged in conservation practices for generations, and they are active partners with universities and government agencies in research and the implementation of soil, water and wildlife conservation practices.

Conservation spending in Arkansas:

Soil & Water - $385.4 Million
Wildlife - $52.6 Million

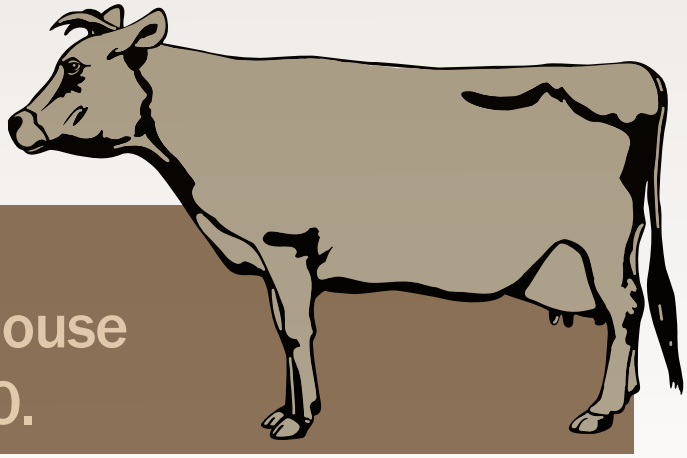
Arkansas is a leading participant in the USDA Natural Resources Conservation Service (NRCS) Programs Environmental Quality Incentives programs, including the Wildlife Habitat Incentive Program and Wetlands Reserve Program.

Arkansas is number one in the nation in USDA NRCS financial assistance with $157 million spent in programming. Arkansas continues to be on the forefront every day, working with private landowners and farmers to help them conserve and restore our natural resources.

Implementing conservation practices is important because it will help preserve the estimated 10-12% of arable land around the world.

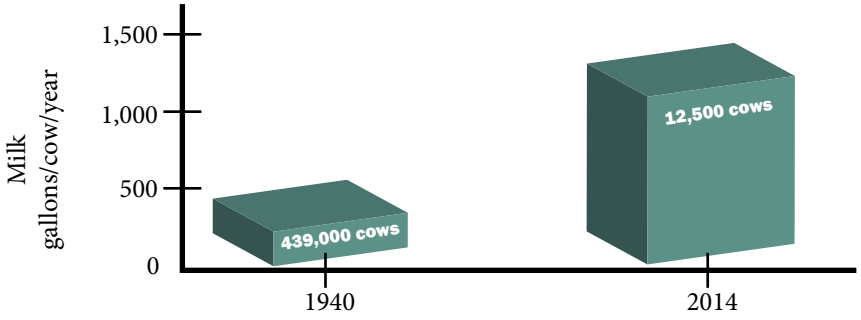
Advancements in management practices in dairy production have resulted in a more sustainable industry.

Dairy

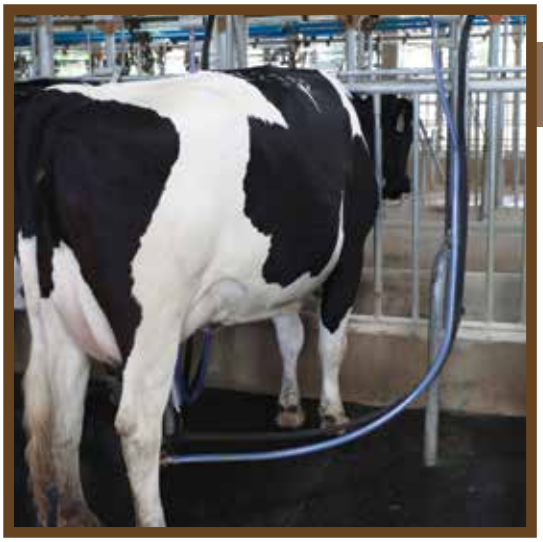


The U.S. dairy industry has committed to reducing greenhouse gas emissions by **25%** by 2020.

Dairy products have been a staple of the American food supply since the original colonies were established. The 20th century saw advancements that improved the quantity and quality of dairy products for the American consumer. Electricity in rural areas and refrigerated transport allowed for bulk storage and movement of dairy products across much greater distances than was previously possible. Advancements through research and farmer-led initiatives brought about better nutrition, better herd health, automated milking systems and better genetics, including the use of artificial insemination. These advancements increased efficiency and production, resulting in more product from fewer animals.



In addition to better genetics, nutrition and herd health, the modern dairy farm incorporates significant management practices to protect the environment and conserve resources. Nutrient management plans for animal manure along with buffer strips near streams and waterways and advanced pasture and crop management have significantly reduced the use of resources and environmental impact.



2014 vs. 1944

Environmental Reduction

- 90% less land
- 79% fewer animals
- 77% less feedstuffs
- 76% less manure
- 65% less water
- 63% less carbon footprint
- 57% less methane
- 44% less nitrogen dioxide

U.S. cattle producers raise **20%** of the world's beef supply with just **7%** of the world's cattle.

Beef

The beef industry has reduced its carbon footprint by 16.3% between 1977 and 2007.

The dedication of America's cattle producers over multiple generations has developed the most efficient and productive beef industry in the world. Productivity-enhancing technologies have allowed cattle producers to use fewer resources, become more efficient and increase production while continuing to provide quality animal care, optimum health and nutrition. Improvements in the beef industry increase its sustainability and deliver a consistent, high quality, nutritious product to the consumer.

The cattle industry is focused on continued improvements to protect and enhance the environment. Many producers voluntarily employ grazing systems that maximize use, minimize impact, preserve range and promote pasture growth, and provide buffer zones near waterways. Water quality is protected through stream fencing and controlled water crossings and by following guidelines established through voluntary nutrient management plans. Many producers also utilize habitat management plans to feed and protect wildlife.

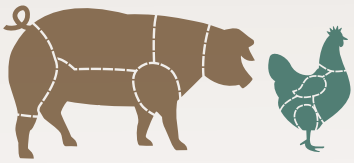
Cattle feedlots follow health protocols for animal care and nutrient management plans for using manure as fertilizer. Cattle feeders often grow many of their feed products and utilize the manure for fertilizer similar to organic production. Manure is sometimes sold to other farmers for the same purpose. Packing plants have increased their use of biogas capture and conversion for energy, and many have switched to using natural gas instead of diesel for other energy requirements.

What would it take to produce the same amount of beef without productivity enhancing technologies?

- **10 million more cattle**
- **17 million more acres of land for grazing and growing feed**
- **18 million more metric tons of CO_2 would be released**
- **81 million more tons of feed**
- **138 billion more gallons of water**

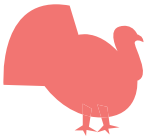
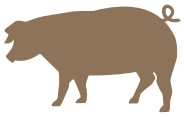
The U.S. poultry industry contributes just **.6%** of total U.S. greenhouse gas emissions.

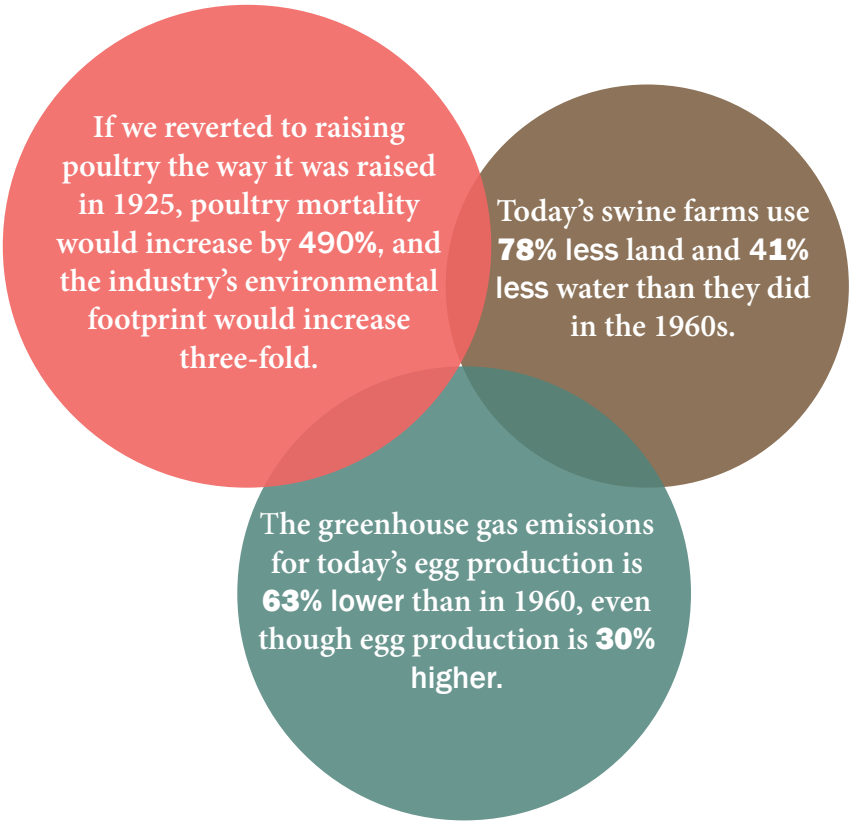
Poultry & Swine



The swine industry contributes just .33% of total U.S. greenhouse gas emissions.

Farmers who raise poultry and swine today utilize similar production systems and practices to efficiently produce a quality product using fewer resources. Both industries have utilized decades of research to increase production through better genetics from selective breeding, optimum nutrition, quality animal health and controlled environments. The majority of poultry and swine farmers raise their animals on contract for vertically integrated poultry or pork companies. This system helps farmers stay on the family farm and take advantage of the research, advancements and resources of larger companies.

1940s		Today
16 lbs. of feed to raise a 4 lb. chicken		<7 lbs. of feed to raise a 4 lb. chicken
29 weeks to raise a 35 lb. turkey		15 weeks to raise a 35 lb. turkey
8 pigs to raise 1,000 lbs. of pork		5 pigs to raise 1,000 lbs. of pork



Controlled environment housing eliminates loss to predators, disease problems from wild birds and varmints and provides optimum growing conditions. Optimal temperature and air quality is achieved using computer controlled ventilation and evaporative cooling. This system also allows the farmer to provide a constant supply of feed and fresh water. Energy efficient LED lighting and integrated natural lighting are replacing less efficient lighting sources. Poultry and swine farmers also use nutrient management plans to manage animal manure, and often use it as fertilizer for other crops they produce or by selling it to other local farmers.

Care of the soil is one of the main priorities for crop farmers.

Soil

Each successive generation of farmers has sought out new methods to reduce erosion, maintain or increase soil fertility and remain productive and profitable. Through research, new techniques and new technology farmers have made considerable progress in soil conservation, staying sustainable and improving the soil for the next generation.

GPS/GIS field mapping:

Enables farmers to use satellite imagery to precisely mark a field, calculate exact acreage, monitor planting and harvesting and evaluate soil nutrient content. Results from soil test samples, crop yields and previous plantings can be used to make detailed management decisions for each field.

Precision agriculture:

A management system that is information and technology based. Farmers use data from soil samples, crops, pest issues, nutrients and moisture to make site specific decisions on a variety of crop and farm management issues. The system is highly dependent on technology and integrated data for each decision. Most new farm equipment allows the farmer to use precision agriculture data to vary planting rates, nutrient usage and pesticide application within the same field.

Conservation tillage:

A system of varying degrees of tillage in crop fields. Farmers will employ conservation tillage methods to control erosion, increase soil fertility, control weed pressure and increase soil moisture. Conservation tillage includes no-till, strip-till and minimum tillage. The farmer analyzes the data and conditions in each field to decide which method or combination of methods may be most appropriate. Conventional tillage may be a part of this system depending on environmental factors and field analysis.

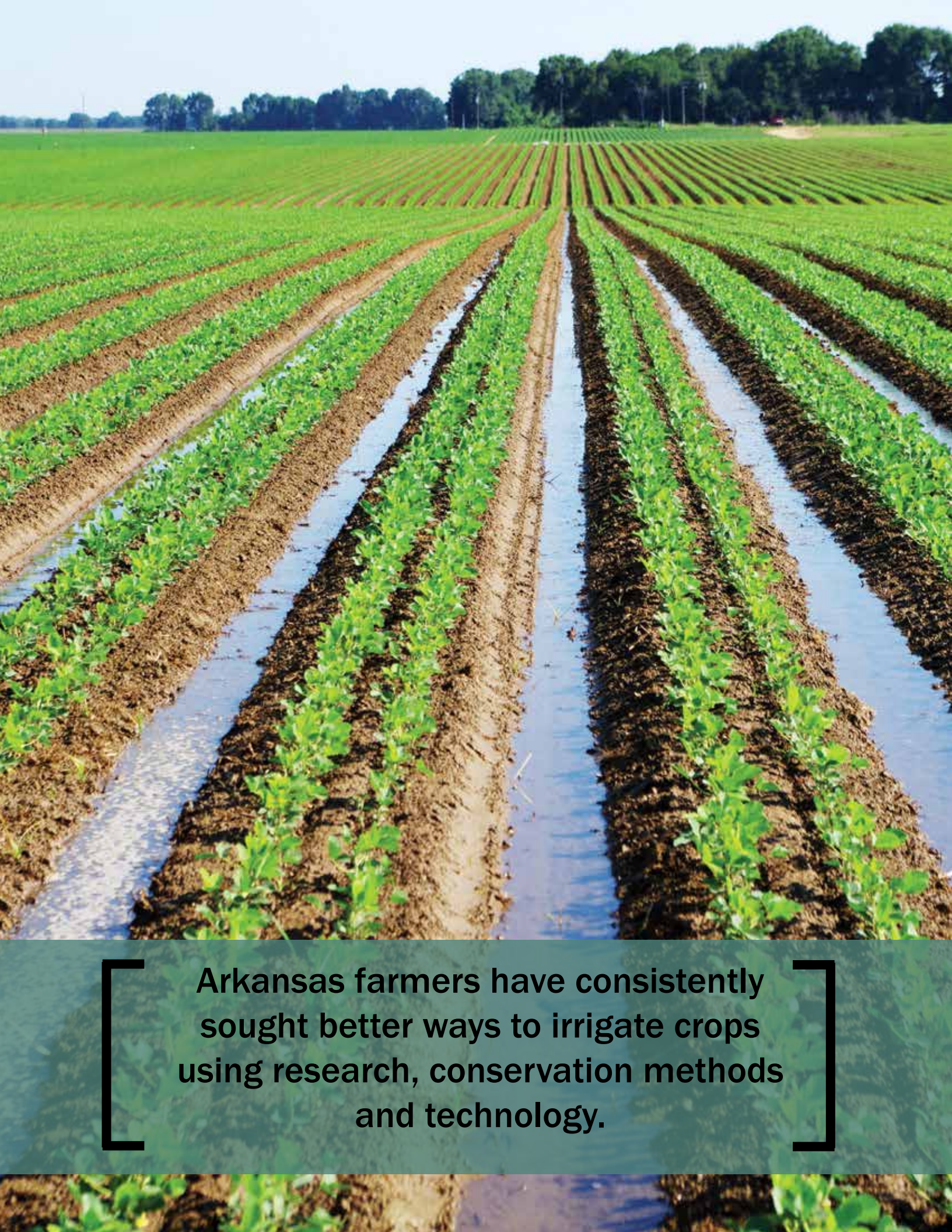
Unmanned aerial systems:

Also known as drones or UAVs, this new technology has great potential to benefit farmers. Data that is gained from UAVs can be used as part of a precision agriculture system to increase efficiency, control costs and monitor conservation efforts. UAVs can monitor sunlight absorption in plants, survey crop pressures from insects, pests and weeds, monitor water usage ad spot potential erosion problems.

Cover crops:

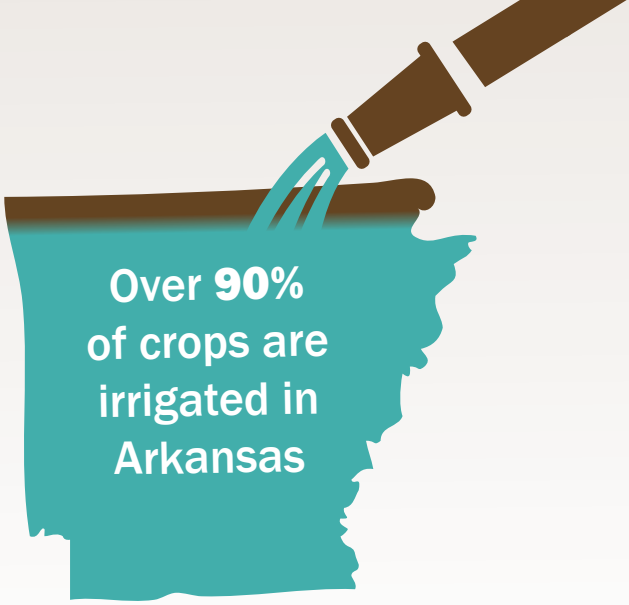
In many highly erodible areas farmers are using cover crops to control erosion outside of the growing season. Cover crops are usually a type of clover or annual grass that is planted in the production crop stubble following harvest. They can be a part of an overall management system to control erosion from wind and water, retain soil moisture and improve soil fertility and organic content.

Farmers have reduced soil erosion 44% since 1982.



Arkansas farmers have consistently sought better ways to irrigate crops using research, conservation methods and technology.

Water



Farmers know that irrigation can help prevent losses from drought and improve yields. Farmers also know that water for irrigation must be used as efficiently as possible to conserve what is arguably the most valuable resource we have. Arkansas farmers have consistently sought better ways to irrigate crops using research, conservation methods and technology.

Resevoirs and tailwater recovery:

Conserving groundwater is a high priority in the future of water conservation. Groundwater is still a major source of irrigation, but more farmers are shifting to using surface water. On-farm reservoirs are being constructed on marginal cropland to capture rainwater, surface water and reclaimed irrigation water from tailwater recovery systems. These systems range from the simple to the complex and employ multiple variations of water transport. These systems of irrigation may use pumps, underground pipe and canals to move water to crops.

Computer controlled irrigation:

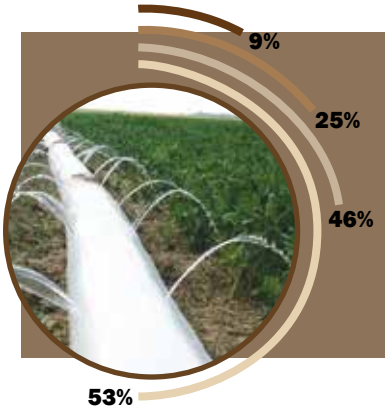
This technology allows farmers to control the exact timing and duration of irrigation. Farmers usually have this technology and data incorporated into a precision agriculture management system that use topography, soil type and environmental data to calculate irrigation schedules. Many of these application can be controlled from smart phones, and allow the farmer to make instant adjustments to the system.

Surface water projects:

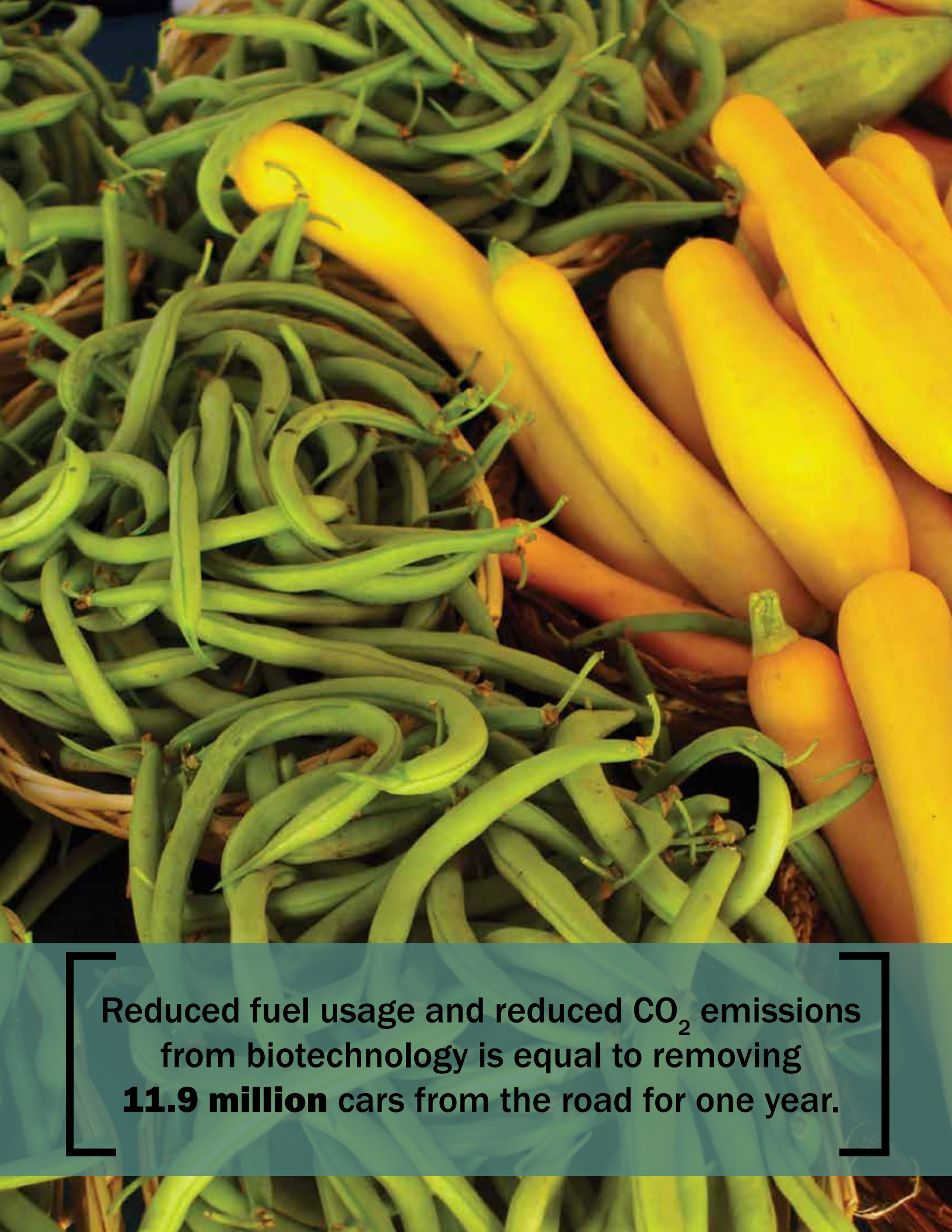
Public-private partnerships between farmers and government agencies are adding to the availability of surface water irrigation. Projects like the Bayou Meto Water management Project and Grand Prairie Irrigation Project will bring surface water to farms and help decrease groundwater usage in agriculture. Many Arkansas farmers are actively participating in the Mississippi River Basin Initiative by voluntarily incorporating conservation efforts into their farm management practices to further reduce erosion and nutrient loss and enhance wildlife habitat.

Discovery Farms:

Arkansas farmers led the initiative to start and fund this program in Arkansas. The program uses on-farm research of conservation and farming practices to see what methods are working. Arkansas farmers volunteered to have this research conducted on their farms as part of their dedication to constantly improving their farm and conservation efforts. The program records data and provides a real world evaluation of farming and conservation methods affect soil, water, wildlife habitat and overall sustainability.



Since 1980, per acre application of irrigation water has decreased **53%** for corn, **46%** for cotton, **25%** for rice and **9%** for soybeans.



Reduced fuel usage and reduced CO_2 emissions from biotechnology is equal to removing **11.9 million** cars from the road for one year.

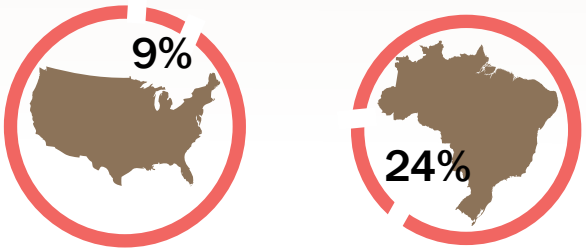
Biotechnology

Corn varieties produced through biotechnology has reduced pesticide use by 8% in the U.S.

Biotechnology is helping Arkansas farmers continue to be sustainable while increasing production to help feed a growing world population. Farmers using biotechnology crops are able to lower their herbicide and insecticide usage, employ more conservation tillage methods, use less fuel and energy on the farm and use less water per acre. Biotechnology is also helping to reduce the greenhouse gas emissions and the eco-footprint of agriculture while preventing deforestation and protecting biodiversity. Farmers in developing countries, many of which are resource poor and farm small plots, received a return of **$3.74** for each dollar invested in biotechnology crop seed.

Without biotechnology we would need a lot more acreage of crops to meet world demand.

- 17 mil. acres more of corn
- 12.1 mil. acres more of soybeans
- 7.6 mil. acres more of cotton
- 49 mil. acres more of canola



This is equal to 9% of arable land in the U.S. and 24% of the arable land in Brazil.

With biotechnology we have been able to decrease pesticide and herbicide use.

Impact of Biotechnology since 1996

- 8.8% or 503 million kg less pesticide usage
- 18.7% less environmental impact of herbicide and insecticide

In 2013, farmers and rural businesses saved **$2.2 million** on energy conservation improvements.

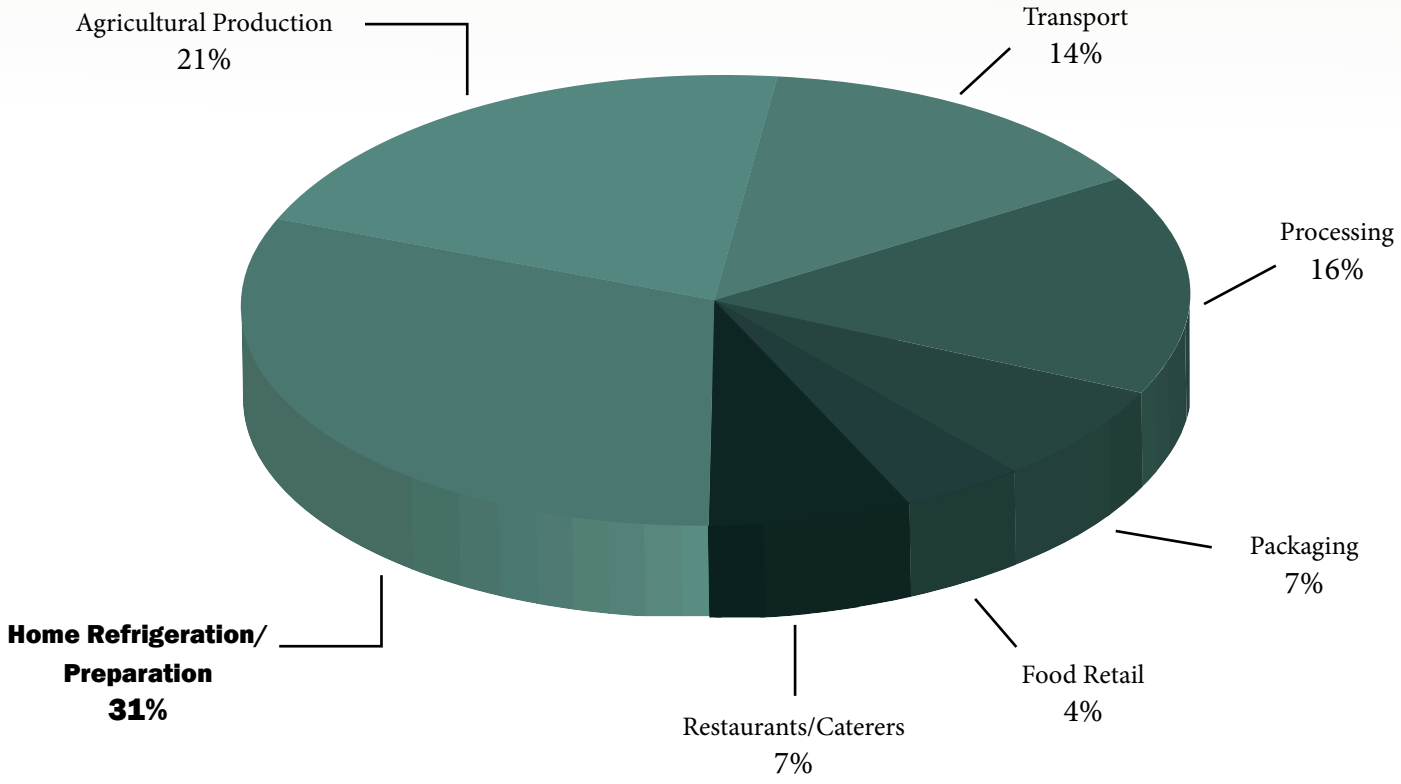
Energy

According to the EPA, agriculture is responsible for only **9%** of total greenhouse gas emissions in the U.S.

Equipment, irrigation, livestock and poultry housing and crop storage facilities are responsible for the majority of energy usage on the farm. Farmers are constantly searching for ways to become more energy efficient including more fuel efficient equipment, electric powered irrigation systems and natural gas heating systems. LED lighting is being used in livestock and poultry housing systems, and many farmers and ranchers are finding uses for solar and wind power in their operations.

United States Food System Energy Use

Total = 10.25 Quadrillion BTU



For More Information

sustainability

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energy

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