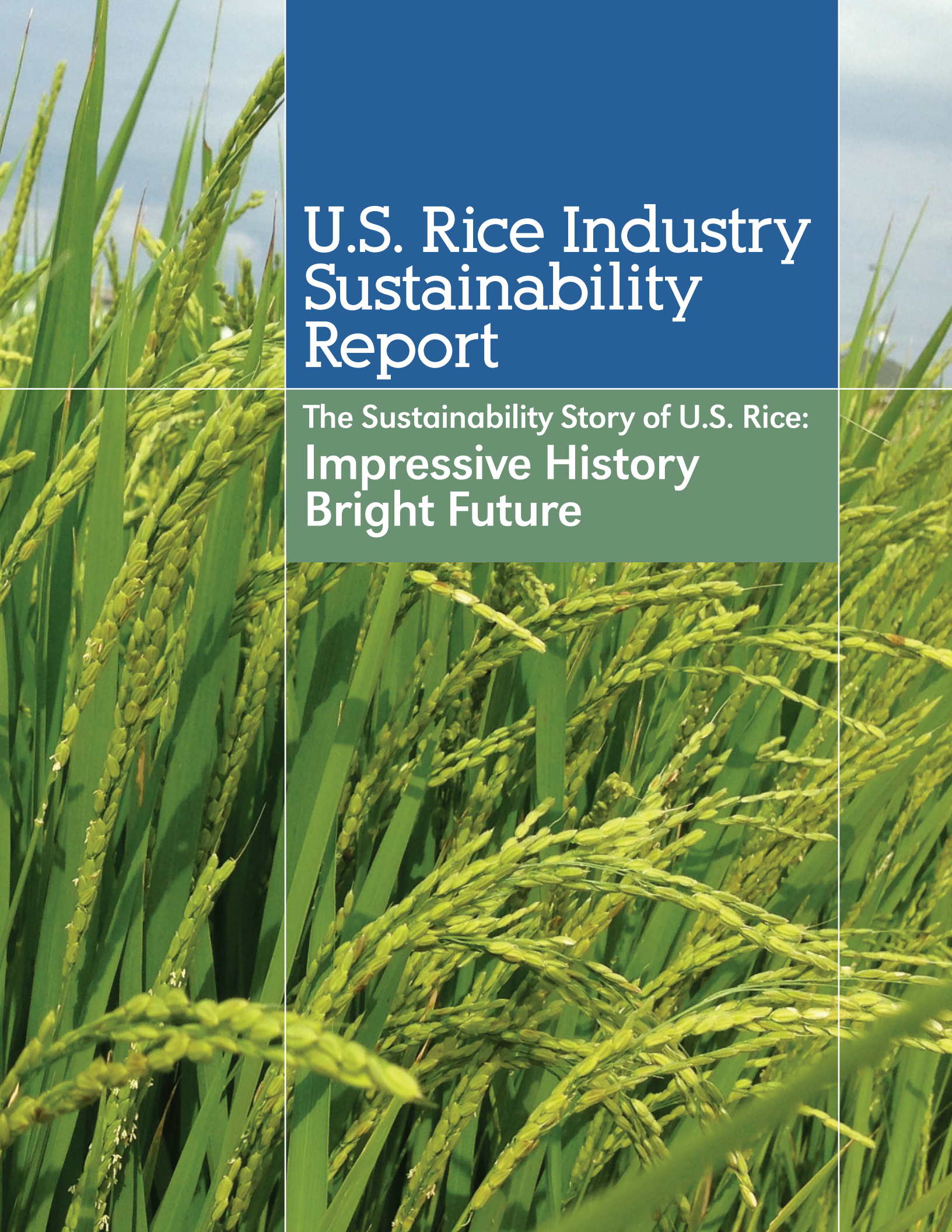


U.S. Rice Industry Sustainability Report

The Sustainability Story of U.S. Rice:
Impressive History Bright Future

Contents

A Letter from The Rice Foundation Director

The U.S. rice industry's commitment to sustainability dates back generations, long before sustainability became a popular term. This first-ever report presents the culmination of sustainability accomplishments over the past 36 years – our greatest sustainability accomplishment being the increase in yields while significantly reducing production inputs at the same time.

Every day the U.S. rice industry strives to meet the demands of growing populations while increasing resource efficiencies at every level of the supply chain. The rice community is invested in using sustainable production and processing practices because it is personal. We provide for our families, serve our communities, protect wildlife habitats, and create jobs. Our stewardship is deliberate, ensuring a healthy, safe food supply, while improving the environment, and contributing to the local economy.

Meeting the requirements of the three pillars of sustainability — environmental, economic, and social — comes naturally to the rice industry. As you read through this report, it is important to recognize the three pillars of sustainability as follows:

Environmental Sustainability – Do practices reduce our impact on the environment while increasing production? Do they improve wildlife habitat, produce cleaner water or cleaner air?

Economic Sustainability – Do practices make or save the farm or mill money? Is the industry creating jobs that sustain communities?

Social Sustainability – Does the industry contribute to the local, national, and/or global community?

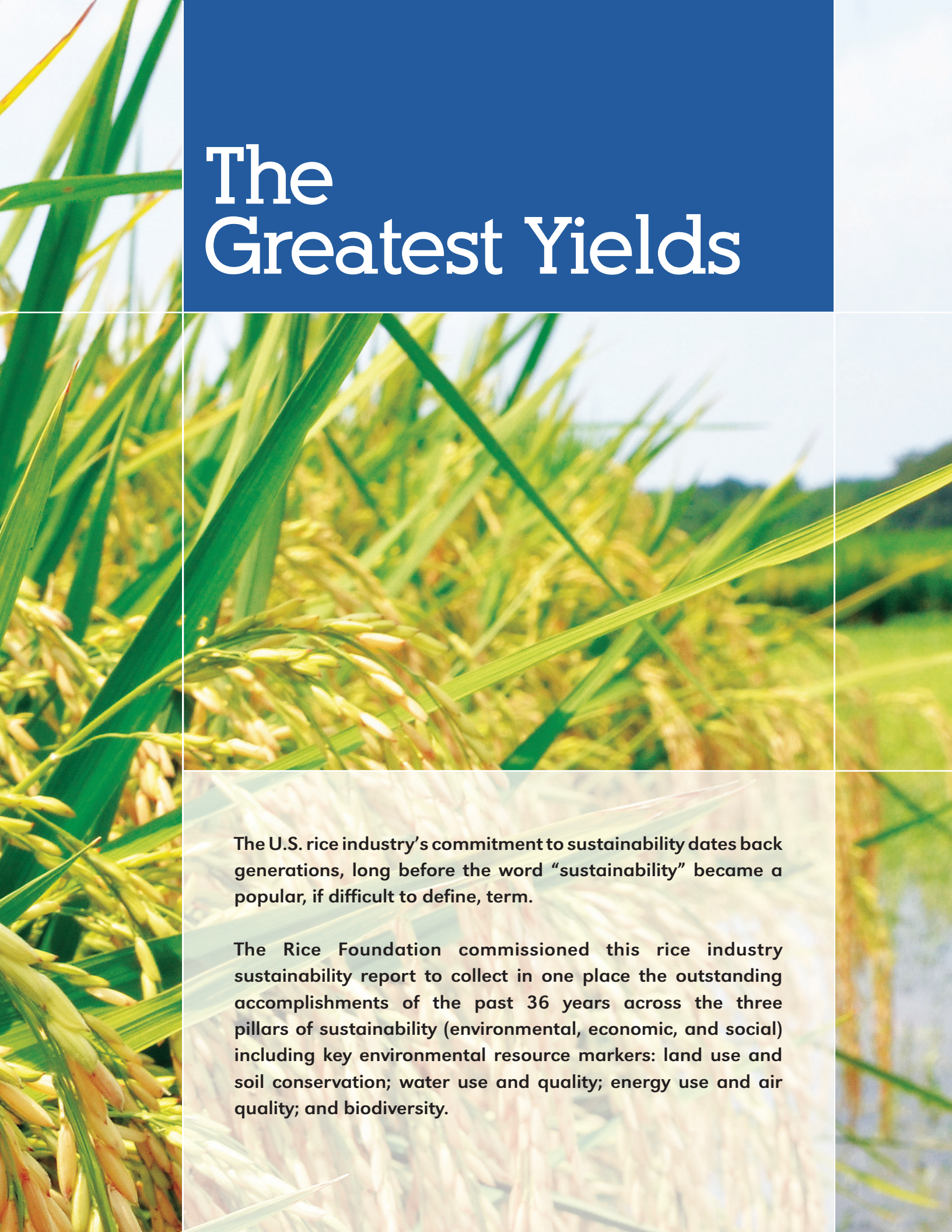
And the rice industry's answer to each of these questions is "YES!" Rice farming has become a precise science involving specialized technology leading to healthier crops, more efficient irrigation and energy use, and improved biodiversity. Rice mills work toward no-waste practices, improving the environment, and creating by-products and renewable energy sources from waste. The rice industry is economically sound, supporting the national and local economies as well as providing billions of dollars in economic output and labor income. We are deeply committed to serving our communities, working with local foodbanks, and supporting global foreign aid programs.

Going forward, technological advances, such as the automation of water control structures along with remote sensing technology and variable rate technology for fertilizer and spray, provide a promising future for enhanced sustainability practices. Recognizing the rice industry's success and historic commitment to sustainable practices, conservation and other public and private partners are investing in the future of sustainability and our shared goals of continuous improvement.

This report captures the sustainability story of U.S. rice farmers and millers, and I invite you to learn more in the pages that follow.

Sincerely,

Steve Linscombe, Director
The Rice Foundation



The Greatest Yields

The U.S. rice industry's commitment to sustainability dates back generations, long before the word "sustainability" became a popular, if difficult to define, term.

The Rice Foundation commissioned this rice industry sustainability report to collect in one place the outstanding accomplishments of the past 36 years across the three pillars of sustainability (environmental, economic, and social) including key environmental resource markers: land use and soil conservation; water use and quality; energy use and air quality; and biodiversity.

Nearly 85 percent of the rice consumed in the United States is U.S.-grown on family farms across the six major rice-producing states: Arkansas, California, Louisiana, Mississippi, Missouri, and Texas. Rice farmers harvest roughly 20 billion pounds of rice grown on 2.8 million acres of sustainably managed farmland. The rice not consumed domestically—roughly 50 percent of the crop in most years—is exported to more than 120 countries around the globe.

Over the past 36 years, improved sustainability practices have led to increased crop yields while also yielding some of the greatest environmental benefits.

Rice conservation practices continue advancing and evolving, and the goal remains the same: produce more rice while using less water and less energy; improve water quality, air quality, and soil conservation; and enhance wildlife habitats to support biodiversity. All without the use of genetically modified organisms (GMO's).

Rice yield per acre increased 62 percent between 1980 and 2015 as determined by Field to Market in the 2016 National Indicators Report.[1] Production increases have also been significant. In 1980, total rice production was 146 million hundredweights compared to 193 million hundredweights of rice produced in 2015, a 32 percent increase.

Sustainability and conservation may begin at the farm, but these important values continue at the mill and down the food supply chain. The U.S. rice industry is working to ensure the principles and accomplishments of our men and women are recognized for what they are: second-to-none.

The unique structure of USA Rice and its existing cohesive working relationship between farmers, millers, merchants, and other stakeholders has enabled the U.S. rice industry to come together through its Sustainability Committee to work on common goals moving rice sustainability forward.

The U.S. rice industry is proud of its accomplishments and will continue to improve, leading the world in on-farm production efficiencies, environmental improvements, wildlife preservation, and food safety.

GROWN IN THE USA
RICE

Where you see the Grown in the USA logo, you can be assured that you are buying healthy, sustainable, U.S.-grown rice.

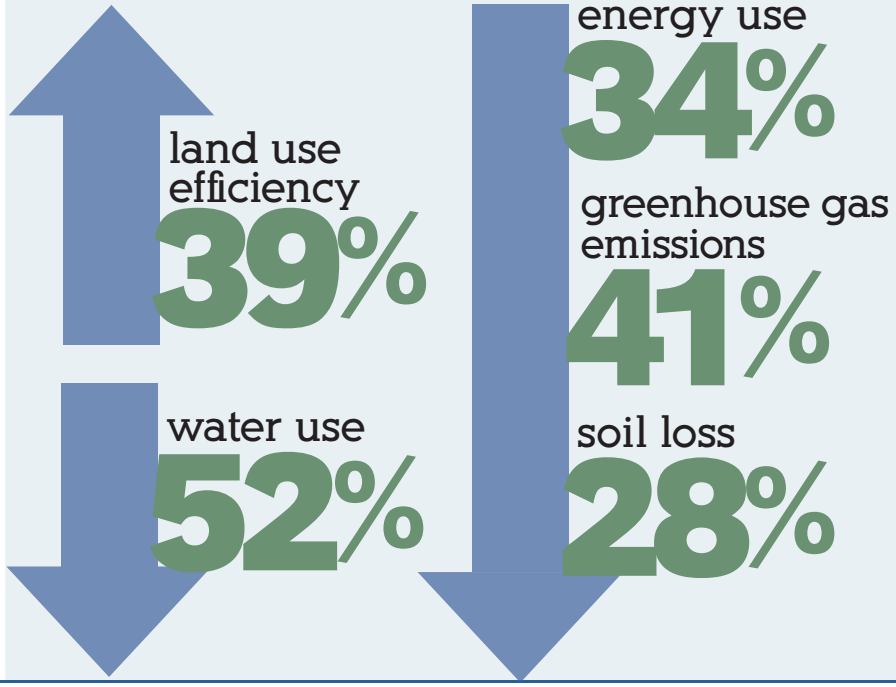
"While the scores for rice within the various metrics have fluctuated over the years, we have not stopped improving overall from where we were in 1980. We can't only look at a snapshot of our records to determine where we are for the long-haul. It's important to look at the big picture to see just how far we've come."

— Jennifer James, Arkansas rice farmer, chair of the USA Rice Sustainability Committee

U.S. Rice and Reduced Environmental Impacts: 1980 – 2015

(Per hundred pounds of rice produced)

Field to Market 2016 National Indicators Report (Based on linear trend analysis, 1980 – 2015)



All segments of the U.S. rice industry are invested in sustainable production and milling practices because it is personal – rice farmers often live on the land they work, and rice mills are important economic drivers in their communities. Together they provide tens of thousands of jobs and inject billions of dollars into the economy — all while standing on a strong record of environmental stewardship.

In 2015, the value of U.S. rice production was $2.4 billion.[2] Farming alone was estimated to have a total output effect on the U.S. economy of $5.65 billion, providing more than 31,700 jobs.[3] Rice milling operations constitute a significant sector of the U.S. rice industry, and economic contributions of rice milling were estimated to be $9.34 billion in 2016 in total output value.

The net economic contribution of U.S. rice milling on the U.S. economy was $3.5 billion (including forward market linkages).[4] Innovative techniques and improvements in U.S. rice production have reduced the time spent in fields to just seven man-hours per acre as compared to the 300 hours often still required in less developed countries.[5] All while, rice farms and mills abide by a range of laws and regulations ensuring the safety of their workers and environmental compliance.

As the main economic driver for many small communities, the rice industry is committed to giving back through a variety of activities including sponsoring community sports and recreation and donations to local food banks, to name a few.

Land stewardship is a long-term commitment to and an investment in the future, supported by collaborative partnerships. U.S. rice farmers participate in several USDA Natural Resources Conservation Service (NRCS) programs. They work with Ducks Unlimited and USA Rice through the Rice Stewardship Partnership to enhance and promote voluntary participation in sustainable production practices. Farmers and millers are also partnering with end users to discuss how to achieve common goals and consider how various sustainability platforms can help to measure improvements toward those goals.

Research and technology help advance conservation practices and further improve efficient use of environmental resources. Sprinkled throughout this report are several stories highlighting these efforts. For example, farmers using more efficient irrigation systems have positive impacts on soil and water use. Some of these same irrigation practices also help conserve energy, while renewable energy sources are also being used to decrease energy use.

As consumers and the food industry demand more sustainable products and world population continues to increase, the U.S. rice industry is one step ahead, working to improve and building upon the rice story for a sustainable future.

Land Use and Soil Conservation

In 2018, U.S. rice was grown across 2.8 million acres of land in six states: Arkansas, California, Louisiana, Mississippi, Missouri, and Texas, an area approximately the size of 2 million football fields, or three times the size of Rhode Island. U.S. rice farmers respect the land they work. They believe in conservation practices to maintain and improve their land for the next generation.

2.8 million acres of land

Land Use and Soil Conservation

Increasing demands on land use in the United States necessitate the most efficient use of land for any given purpose. In agriculture, efficient land use means producing more crop on less land. Field to Market measures land use by the amount of land required for a unit of production—for rice, the acreage to produce one hundred pounds of rice (hundredweight). In the 36 years measured in the 2016 Field to Market National Indicators Report, land use showed steady improvements with a 39 percent overall decrease in planted acres per hundredweight from 1980 to 2015.

In the same 36-year period soil conservation, representing soil erosion from wind and water, improved on a per acre basis with a 28 percent decrease in soil loss. Due in part to the unique nature of rice production practices, erosion hasn't been a major problem for rice. Heavy clay and silt loam soils that are often ill suited to other crops retain water very well, making them perfect for rice. Erosion continues to decline due to rice cultivation practices such as land leveling for flood irrigation and innovative water control structures, making rice one of the lowest per-acre soil erosion crops.

Precision land leveling uses GPS and laser-guided earthmoving equipment to create uniform grades and slopes within fields. It facilitates surface drainage and more efficiently distributes irrigation water. Good land leveling practices can produce greater crop yields, improve weed control, provide a larger farming area with fewer levees, and reduce seeding times.

Isbell Farms, a fourth generation rice farm in England, Arkansas, uses zero-grade farming, which was pioneered by the late Leroy Isbell. Zero-grade farming uses precision-leveled fields without interior levees for more efficient water use. Leroy found that this technique allowed for much more efficient farming using 30-50 percent less water compared to conventional levees. Amazingly, he successfully created this technique without the use of modern laser leveling equipment. Today, Isbell Farms remains a family-run operation and continues Leroy's legacy of conservation practices.

Soil conservation practices such as conservation tillage—in which rice is planted with no or minimal tillage into previous crop residue or a stale seedbed—protect the soil from erosion, loss of nutrients, and salinization. Keeping organic matter in the soil helps to improve soil health, and it naturally saves energy and reduces carbon dioxide emissions by requiring fewer tractor passes through the field.

soil erosion

28%

per acre

On a per-acre basis, rice consistently demonstrates the lowest per-acre soil erosion of all six crops examined.

— Field to Market 2016 Indicators Report

Conservation tillage is a practice used primarily in southern rice growing states, where the potential damage of wind and water is much greater. Conservation tillage practices have significantly improved soil retention. As farmers continue to adopt conservation tillage practices, improvements in soil retention will continue.

In Louisiana, researchers at LSU Ag Center found that no-till and reduced tillage practices in commercial rice production had increased by 57.7 percent, from 26 percent in 2000 to 41 percent in 2011.[8]

Under the National Rice Regional Conservation Partnership Program (RCPP), producers in Southeast Missouri held winter rainfall on 13,390 acres in winter 2016-2017. Approximately two-thirds of these acres were no-till while the remaining third was tilled after harvest. If these acres had been traditionally tilled in the fall and rainfall allowed to leave the field, a total of 6,680[7] tons of soil would have been lost from fields. With the increased adoption of conservation tillage practices and holding winter rainfall, farmers reduced soil losses by 88 percent and prevented 380 dump trucks of soil from entering the waterways of Southeast Missouri.

SUSTAINABILITY IN ACTION:

Christian Richard is a sixth-generation rice farmer with a desire to leave the land better than it was before. As he says, "U.S. farmers should not be afraid to tell their story. How we are being productive while conserving natural resources and maintaining the safest food supply in the world." Through his participation in multiple USDA NRCS programs, Christian has integrated beneficial conservation practices throughout his farming operation, including precision leveling and conservation tillage. Additionally, he installed a state-of-the-art tailwater recovery system that uses an abandoned 120-year-old canal, 100 feet wide by almost a mile long, as a reservoir to hold water that can be pumped on or off his rice fields.

Christian participates in the NRCS Gulf of Mexico Initiative. Through this program, NRCS invested $4.3 million supporting conservation practices on 36,000 acres in the lower Mermentau River watershed.[9] While the program largely seeks to improve water quality in the Gulf, it has the added benefit of improving soils. Through the financial assistance provided by the Gulf of Mexico Initiative, Christian uses several practices to mitigate runoff from his farm in addition to land leveling and conservation tillage, including ground stabilization, nutrient management, and tailwater irrigation. Practices like these help Christian move water efficiently across his fields and hold the soil in place, minimizing erosion and nutrient loss. These efforts also contribute to visibly clearer water, a good sign that the water quality is improved through Christian's conservation management practices. The Gulf of Mexico initiative supports growers like Christian across the region to put into place resource saving practices.

> "U.S. farmers should not be afraid to tell their story. How we are being productive while conserving natural resources and maintaining the safest food supply in the world."
>
> — Christian Richard, Louisiana Rice Farmer

Water Use and Water Quality

U.S. rice farmers use a variety of management strategies to irrigate their fields, sourcing ground water from wells or surface water from rivers, streams, lakes, bayous, and reservoirs to irrigate the land. Farmers strive to reclaim and recycle as much surface water as possible, which is better for their bottom line and better for the environment.

Water Use

52%

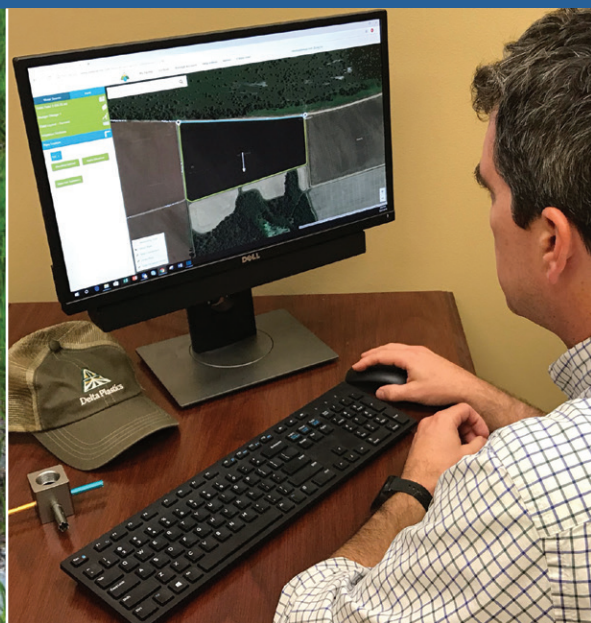
Flooded fields prevent soil erosion, and new innovative irrigation methods significantly reduce water use and lead to improved water quality, as well as other environmental benefits. Some more commonly used water conservation methods include alternate wetting and drying (AWD), furrow-irrigation, multiple inlet irrigation, and tailwater recovery systems. Farmers use a combination of these water conservation methods to create a system best suited to their water infrastructure. Additional practices such as filter strips, riparian buffers, Integrated Pest Management (IPM), and 4R nutrient management may be used in conjunction with various irrigation methods to preserve water quality.

As a result of these practices and increased yield, rice farmers reduced irrigation water use by an impressive 52 percent between 1980 and 2015 according to Field to Market analysis.[10] Whereas farmers used 0.80 acre-inches of water per hundred pounds of rice produced in 1980, they were able to use significantly less in 2015 at 0.46 acre-inches of water per hundred pounds of rice.

Flooded fields prevent soil erosion, and new innovative irrigation methods significantly reduce water use and lead to improved water quality, as well as other environmental benefits.

Private-Public Partnerships: Advancing Water Management Technology and Conservation

With the advent of poly tubing in the late 1980's, USDA Natural Resource Conservation Service (NRCS) staff in Missouri began hearing from farmers who were experiencing issues with regulating water pressure and flow often resulting in pipe bursts. In response, NRCS engineers developed calculations to help farmers determine sizing of holes for flow volume and uniformity of water distribution. These calculations were programmed into a newly emerging work place computer Disk Operating System (DOS) so results could be obtained more quickly, leading to the creation of the program known as PHAUCET. Later upgrades were made to the Windows system, and while utilization of the program spread throughout the mid-South and led to more efficient use of poly tubing, it still required NRCS and Extension staff assistance. With today's advances in technology and ready access to data, the tool needed another upgrade to get it into the hands of farmers to use the program on their own devices. A unique private-public partnership between Delta Plastics and NRCS led to the creation of Pipe Planner made available for free to all farmers in 2014. This Web-based application allows farmers to input easily accessible data to maximize potential for achieving uniform water application, resulting in up to 25 percent reduction in energy costs.



SUSTAINABILITY IN ACTION:

Alternate wetting and drying is critical to the successful conservation practices on Jim and Sam Whitaker's farm in Arkansas. Their farm uses 60 percent less water than the state average for rice production, and reduces nitrogen use by 20 percent with increased yields. "Now, we're using less water than soybeans, corn, or cotton. Rice is the most ecologically friendly crop we can plant, if we manage it properly," stated Jim.

The Whitaker brothers use fully-automated water sensors in their rice fields that are controlled remotely by hand-held devices. The system controls the irrigation pump, turning the water on and off at pre-set levels. It also monitors the field and water levels every seven minutes, 24-hours per day.

A two-year field study reveals a water savings of 624,000 gallons per acre. That's an impressive total of 4.3 billion gallons of water saved during the 2016 growing season. Additionally, their system results in a smaller carbon footprint, reducing methane gas emissions to the atmosphere. The Whitakers found that through the carbon market they can generate about one ton of carbon credit per acre, and they made history for being among the first farmers to sell carbon credits generated by rice production. The Whitakers have been using technological advances to improve farm conservation for more than 20 years, and they were the first recipient of the USA Rice Sustainability Award in 2017.

Continuous Flooding

Continuous flooding is the traditional form of rice irrigation. In this system, once water is applied to a field, that flood is maintained until the field is drained prior to harvest. It facilitates weed control, reduces the need for herbicides and additional fertilizers, and improves water quality. Fields are leveled to have a slight slope, allowing gravity to move the water from the high side of the field, where the well or surface water source gate is located, to the low side of the field. Depending on the soil type and the amount of water that evaporates or is used by the plants, the farmer will add additional water to the field to keep water levels at an optimal depth of two to four inches.

Multiple-Inlet Rice Irrigation

Multiple-Inlet Rice Irrigation (MIRI), also known as side-inlet rice irrigation, is a practice in which each area between the levees is simultaneously irrigated. This method eliminates the need for water to flow from one levee to another, reducing the amount of time it takes to get water from one end of the field to the other, and allowing the farmer to control water movement by using underground irrigation risers or recyclable polyethylene tubing that can be opened and closed depending on the section to be watered. MIRI has been found to reduce total water use by an average of 25 percent. The practice allows for quicker application of water, which is important not only for irrigating the crop but also for weed control and fertilizer efficiency. Another advantage of MIRI is that it can be combined with intermittent flooding practices,[11] the precursor to alternate wetting and drying in the mid-South.

Reduced water use means both lower energy costs and financial savings. On-farm trials conducted by Mississippi State University researchers found an 18 percent reduction in water cost over straight levee production practices with MIRI systems, while also reducing time for flood establishment and nitrogen loss as well as improved herbicide activation. MIRI combined with intermittent flooding produced an additional water cost savings of 30 percent over a four-year pumping average.[12] University of Arkansas researchers found similar results when intermittent flooding was coupled with MIRI, showing water use over three years averaged 32 percent less than comparable MIRI systems not using intermittent flooding.[13]

Alternate Wetting and Drying

Alternate Wetting and Drying (AWD), sometimes called intermittent flooding, saves water in southern U.S. rice production systems without negatively impacting crop yield. With AWD, once the initial flood is established, fields are allowed to partially dry and then water is applied again with careful monitoring and efficient pumping systems. This process maximizes the use of captured rainfall, reduces total water use, and saves money with reduced pumping fuel costs. By maintaining a less than full flood and with careful oversight, irrigation water use can be reduced. Periodically non-saturated soils also reduce methane emissions, adding a second benefit to the practice.[14]

Researchers affiliated with Mississippi State University, University of Arkansas, and USDA-Agricultural Research Service (ARS) have studied the effects of AWD practices on rice crops and found multiple benefits. Jason Krutz, an irrigation specialist with the Mississippi State Extension Service, found rice farmers can reduce water use by up to 30 percent without hurting yields. AWD "saved an average of $50 (per acre) per season across fields ranging from 20 to 80 acres," Krutz said.[15]

Furrow Irrigation

Furrow-irrigated rice, also known as row rice, is a conservation practice that is growing in popularity among rice farmers in the South. Rice is planted using a standard grain drill, but instead of planting on flat ground, the ground is 'bedded,' or 'hipped' to allow for irrigation water movement across the field. Furrow spacing varies from 30–78 inches while the rice is planted in rows ranging from 7-10 inches. Water then flows down the furrows and seeps vertically and horizontally to refill the soil reservoir. Water flows more efficiently with furrows because the entire surface is not wetted, thus reducing evaporation losses. Furrow irrigation requires less land preparation with no interior levees, and it allows farmers to decide later in the planting season if they want to grow rice, soybeans, cotton, or corn.

Ease of crop rotation and less field work attracted farmer Ryan Sullivan to experiment with furrow-irrigated rice. Ryan operates Florenden Farms with his father, Mike, in Burdette, Arkansas. Seeking more efficient ways to operate their 13,000-acre farm, Ryan changed to row rice on some of their land. When

Furrow-irrigated rice is a conservation practice that is growing in popularity among rice farmers in the South ... the ground is 'bedded,' or 'hipped' to allow for irrigation water movement across the field.

SUSTAINABILITY IN ACTION:

Johnny Hensgens was the first farmer in Louisiana's Calcasieu Parish to build a tailwater recovery system. As the story goes, his neighbors thought he was building a giant pond. But instead, he was building a modern system to capture and reuse his own surface runoff from watering his crops, including nearly 1,000 acres of rice. Working with his local USDA Natural Resource Conservation Service (NRCS) office, Johnny received technical and financial assistance for a tailwater recovery system through the Environmental Quality Incentives Program (EQIP). The Calcasieu Parish is home to the Chicot aquifer, the most extensively pumped aquifer in the state. By using a tailwater recovery system, Johnny helps keep the aquifer at healthy water levels because the aquifer is now a secondary source of water instead of his primary source. In addition to saving water, saving soil, and saving nutrients, the farm is saving money – according to Johnny about $30,000 per year. "As a rice producer, conservation is a major concern. We have to protect the water and the soil," says Johnny.

> "As a rice producer, conservation is a major concern. We have to protect the water and the soil."
>
> — Johnny Hensgens, Louisiana Rice Farmer

farmers rotate rice using continuous flooding with other crops, the levees must be taken down after harvest. The Sullivans can reduce trips across the field and practice no-till in their rice-soybean rotation using furrow-irrigated rice because they don't have to take down levees. The Sullivans are saving water, saving energy, increasing time efficiencies, and improving their ability to rotate crops.

Tailwater Recovery Systems

Tailwater is the irrigation water that runs off a field. Tailwater recovery systems conserve irrigation water supplies through capture and reuse. Farmers recycle captured run-off water and use it to irrigate their crop immediately, or they pump it back into a reservoir to use later. Up-front costs for tailwater recovery systems can be high, but the benefits of water reuse pay off long-term.

In California, most tailwater is used by other downstream users and the environment. The water not used by other croplands generally flows back into the rivers and wetlands, with 57 percent of the managed wetlands in the Sacramento Valley using tailwater from the Valley's rice fields. Rice farmers in California have also seen steady improvements in water use efficiency with practices including land leveling, recirculation systems, the use of early maturing varieties, and the development of water-conserving irrigation systems.

Water Quality

Excess sediments and nutrients can negatively impact water quality. Growing rice is a natural filtration system removing sediments and nutrients as water moves through the field, thus water leaving rice fields is cleaner than when it went in. Water management practices such as conservation tillage, land-leveling, filter strips, and riparian buffers reduce run-off and make water cleaner and clearer. For example, using grass filter strips can reduce soil, nitrogen, and phosphorus losses by as much as 52 percent.[17]

Water quality issues, such as soil erosion and sediment transport, saline drainage waters, and high concentrations of trace elements in subsurface drainage, are not usually a problem with rice production because of the slow continuous rate of flow through rice fields during irrigation.

However, in the late-1970s in California, the rice industry identified negative impacts of two rice herbicides reaching high detection levels in the drains. Studies there began to identify the environmental impact of these herbicides and the flow of rice field drainage. Farmers and members of the rice industry worked with regulatory agencies and the University of California to mitigate negative impacts through implementation of water holding requirements to degrade pesticides to an acceptable level before discharge. Further collaboration led to the formation of the Rice Pesticide Program under the leadership of two major regulatory agencies working with a range of stakeholders, including rice farmers and industry representatives, pesticide manufacturers, and applicators. This effort has resulted in significant reductions of pollutants in major agricultural drains in rice production areas with concentrations falling to non-detectible levels since the program's inception. The resulting Rice Pesticide Program exemplifies successful mitigation of a major rice herbicide still in use that can be achieved through a proactive approach to collaboration.[18]

Practices like conservation tillage, land-leveling, filter strips and riparian buffers, Integrated Pest Management (IPM), and 4R nutrient management reduce run-off and make water **cleaner & clearer**

Research in Water Management Treatments

Rice farmers Mike and Ryan Sullivan near Burdette, Arkansas, are always trying to find ways to be more efficient with water. One way they do this is by participating in research. Beginning in 2017, their farm was part of a two-year study on irrigation water management practices and their effect on water use, crop yield, and milling quality. Dr. Michele Reba, a research hydrologist and lead scientist with the USDA-Agricultural Research Service Delta Water Management Research Unit is taking her unit's small plot research on practices such as Alternate Wetting and Drying (AWD) and applying it to a farm-scale trial on 16 of the Sullivan's fields (4 replications of 4 quadrant trials). First-year results showed a reduction in water use and methane emissions (due to the dry-down in AWD), but no statistical difference in yield when compared to conventional irrigation methods.

In Louisiana, water quality evaluations have been conducted on six farms through the Regional Conservation Partnership Project (RCPP) of the Rice Stewardship Partnership. These six farms use surface water from adjacent bayous to irrigate their crops. The amount of suspended solids was measured when the water was lifted from the bayou and when the water was drained from the rice field. Measurements showed that when water left the rice field, the amount of suspended solids was five times less than when water was pumped on the field.

Nutrient Management

Most U.S. rice farmers adhere to the 4R Nutrient Stewardship principles of applying fertilizer at the Right source, Right rate, Right time, and in the Right place. These principles identify opportunities to improve fertilizer efficiency and prevent nutrient movement in each field. In addition to applying 4R principles, farmers can plant filter strips and riparian buffers. Filter strips consist of dense vegetation such as grass, shrubs, or trees. They are most effective when used in combination with other conservation practices such as riparian buffers. Riparian buffers are trees or shrubs planted adjacent to a river, stream, wetland or water body. Filter strips and buffers act as natural nutrient managers. They prevent soil erosion, filter runoff, and remove contaminants to improve water quality.

Winter Flooding

Practices such as winter flooding improve water quality and provide wildlife habitats. Post-harvest winter flooding practices increase straw decomposition rates, reduce winter weeds, and improve soil retention and water quality. Additionally, rice stubble maintained in the field can save on disking, herbicide administration, and levee repairs, saving $20/acre or more.[19]

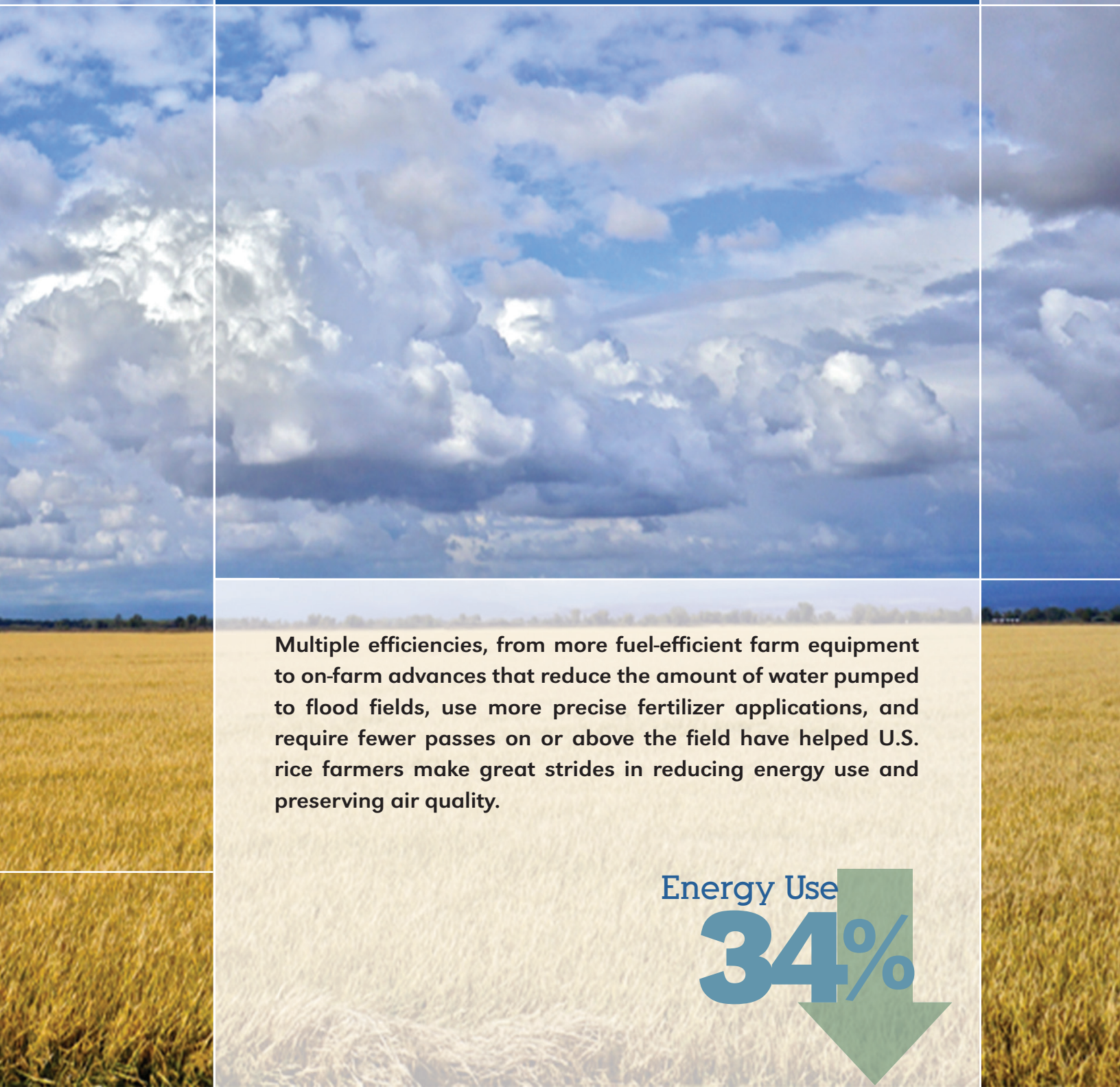
SUSTAINABILITY IN ACTION:

Jennifer James is a fourth-generation farmer who, along with her father and husband, owns and operates her family's 6,000-acre farm in Newport, Arkansas. Land stewardship practices have been a way of life on their farm for more than 100 years. They use several nutrient management practices on the farm, including filter strips and conservation buffers. Additionally, the farm includes multiple tailwater recovery systems to recycle irrigation water and instituted laser land-leveling to further reduce water use and runoff. They have experimented with using many irrigation practices based on geographic conditions and installed moisture sensors to help with irrigation efficiency. Recognized for her commitment to conservation and leadership in advancing sustainable agriculture, Jennifer was the first recipient of Field to Market's prestigious Farmer of the Year Award in 2017. Jennifer's commitment to continuous improvement goes well beyond her family farm. As the chair of the USA Rice Sustainability Committee, she represents U.S. rice farmers and tells their conservation story on the national level.

"Why would a farmer want to waste anything? It costs money to pump every gallon of water so we are conservative in order to stay profitable."

— Ryan Sullivan, Arkansas Rice Farmer

Energy Use and Air Quality



Multiple efficiencies, from more fuel-efficient farm equipment to on-farm advances that reduce the amount of water pumped to flood fields, use more precise fertilizer applications, and require fewer passes on or above the field have helped U.S. rice farmers make great strides in reducing energy use and preserving air quality.

Energy Use

34%

Over a 36 year period, energy use in U.S. rice production has decreased by 34 percent.[20]

For example, in California use of diesel fuel, fertilizer, and electricity has been reduced by approximately 20 percent over the last 30 years.[21] Several factors such as improved farm equipment reducing diesel consumption, reduced aircraft passes and aircraft fuel consumption, and use of stripper headers on combines to increase harvest speed contribute to this success.

These improvements have also been made by farmers in the mid-South leading to impressive gains in energy efficiency. Other practices on the rise contribute to energy reductions, such as conservation tillage, saving fuel and decreasing labor hours with fewer tractor passes through the field, and alternate wetting and drying (AWD), saving energy through optimized pump efficiencies.

Irrigation Pump Efficiencies

Smart irrigation practices use energy-efficient equipment and designs to minimize water and energy use. Mechanical improvements to pumps, motors, and engines increase the farmer's control over water application, thus increasing energy efficiency. Technology such as irrigation flow meters help farmers monitor energy as well as water use. Flow meters detect high or low water flow rates, and a change in flow could indicate a problem leading to excessive energy use. Adjustments in the power used to run irrigation pumps will maximize energy efficiency.

Evaluating irrigation pump efficiencies on a regular basis can translate to cost savings for farmers and increased energy efficiencies. Several factors influence pumping irrigation cost such as taxes, insurance, interest, depreciation, maintenance, and energy source (either electric, gas, or diesel). Energy is usually more than 50 percent of the total pumping cost.[22] Energy prices vary depending on the season and market prices. Many farmers choose to vary their energy sources for best performance and cost efficiency. (See Table 1 for Fuel Use Comparisons.)

NRCS and Louisiana State University (LSU) researchers collected data to analyze the pump efficiency of rice farmers' pump setups in the Louisiana Irrigation Well Pump Efficiency Testing Program. The LSU AgCenter conducted tests in 2009 to find the cost of operating irrigation systems and measure the efficiency of diesel and electric pumps. Study results released in 2011 found that one-third of farms could save $16,000 per year if pumping systems were optimized. Electric pumping systems averaged 75 to 85 percent overall energy efficiency while diesel-powered pumps average 18 to 35 percent efficiency.[23]

Renewable Energy Production and Use

Renewable energy, including solar and biofuels, are increasingly being used in rice farming and milling. Rice millers work with power facilities to change a waste product (rice hulls) into a viable energy source, also contributing to the reduction of greenhouse gases.

For example, using approximately 50 percent of the rice hulls produced in the Sacramento Valley, Wadham Energy's biomass facility in Williams, California, can generate the amount of electricity needed to power all associated rice production operations, helping to create a more energy neutral production system. This eliminates the need for the costly disposal of the hulls, while providing the Wadham facility with a continuous supply of material for its energy cogeneration needs. Wadham Energy burns 29 tons of rice hulls per hour, between 600-700 tons per day, producing steam that fuels electricity generators.

Table 1. Fuel Use Comparison

Power Unit Type	Typical Consumption Per Acre-in for Different Pumping Depths†			
	25'	50'	75'	100'
Electric (KWH)‡ (Conventional vertical hollow shaft)	4.0	8.0	12.0	16.0
Electric (KWH) (Submersible)	4.5	9.0	13.5	18.0
Diesel (GAL)	0.3	0.6	0.9	1.1
LP Gas (GAL)	0.5	1.0	1.6	2.1
Gasoline (GAL)	0.4	0.8	1.2	1.6
Natural Gas (CCF)	0.6	1.1	1.7	2.1

NOTE: Typical fuel consumption can vary ± 20 percent due to motor or power unit design, wear, and matching load.

† The pumping plant performance values used in the calculations are based on Nebraska Standards and Arkansas pumping plant tests. The values for gasoline, LP, and natural gas include a 5% drive loss, while no drive loss is considered for electric. All values assume 75% pump efficiency. Typical fuel consumption is based on the system performing at 80% of the best performance possible. Pumping depth is depth to water when pumping.

‡ GAL is abbreviation for gallon; KWH is abbreviation for kilowatt hour; CCF is abbreviation for 100 cubic feet

Source: University of Arkansas System Division of Agriculture, MP192 Arkansas Rice Production Handbook.

Agrilectric is a renewable energy power plant in Lake Charles, Louisiana, that provides enough power to supply surrounding small towns with electricity from burning rice hulls. Agrilectric has worked with the rice industry for 30 years, using more than 4 million tons of rice hulls to produce electricity. That's enough rice hulls to cover more than 600 acres of land fill.[24] After burning the hulls, rice silica is used for products that help soil improvements, the steel industry, and filter aids that remove metals from wastewater.

Solar energy is being used throughout the rice industry value chain, including some on-farm use. Certainly, the up-front costs may not be affordable for all operations, but those who have made the investment find value in the results. Weighing the upfront costs over the long-term benefits, A.J. Hood, a rice farmer from Desha County, Arkansas, added solar panels to his grain storage facilities. Adding solar panels to a little over an acre produced approximately 240,000 kWh of electricity and reduced A.J.'s electric cost by 75 percent. That's enough to power more than 20 American households per year.[25] Solar power is also being used to run irrigation systems, replacing purchased electricity or diesel fuel.

SUSTAINABILITY IN ACTION:

One of the largest rice handlers in California, the American Commodity Company (ACC), has extended its sustainability reach beyond the farm gate to their drying, milling, packaging, and shipping processes. The company's Williams facility uses an 11-acre solar array to generate 1.5 megawatts of electricity annually, exceeding their total yearly usage. By producing more electricity than they use, they can operate year-round on a 24-hour, seven days per week schedule. This maximum utilization of employable assets reduces their per unit carbon footprint. The company is also implementing an ongoing capital improvement program to upgrade to energy efficient lighting throughout their facilities.

Doing its part to eliminate waste and contribute to energy production, ACC sells 100 percent of its rice hull by-product to Wadham Energy's biomass facility. The company has also upgraded its waste water system with a technologically advanced effluent disposal system and has reduced their impact to landfills by 90 percent through aggressive recycling efforts. Finally, 100 percent of paper bags used for packaging are made from post-consumable goods, continuing the sustainability commitment.

Air Quality

Rice conservation practices and innovation can also lead to improved air quality and a decrease in greenhouse gas emissions. Resource efficiencies have improved, with a 41 percent reduction in GHG emissions per cwt of rice produced over 36 years.[26] While greenhouse gas emissions have decreased on a per acre basis as well as an overall basis, it is important to recognize, as the United Nations Framework Convention on Climate Change pointed out, that:

"There are limitations to emissions reductions in the agriculture sector particularly because of the role of the sector in providing food for a global population that is expected to continue to grow in the coming decades. Therefore, it would be reasonable to expect emissions reductions in terms of improvements in efficiency rather than absolute reductions in GHG emissions."[27]

According to the U.S. EPA Inventory, the U.S. agriculture sector as a whole only contributes 7.7 percent of total national greenhouse gas (GHG) emissions (not including energy use on farms). Though agriculture is the number two producer of GHG emissions in the U.S., most of the emissions come from energy use. More than 80 percent of total GHG emissions come from the energy sector.[28]

In the rice industry, farmers and millers must carefully weigh options, seeking to increase sustainability efficiencies and maximize environmental benefits at the same time. New practices and innovations in the past few decades have led to improvements in air quality and reductions in greenhouse gas emissions.

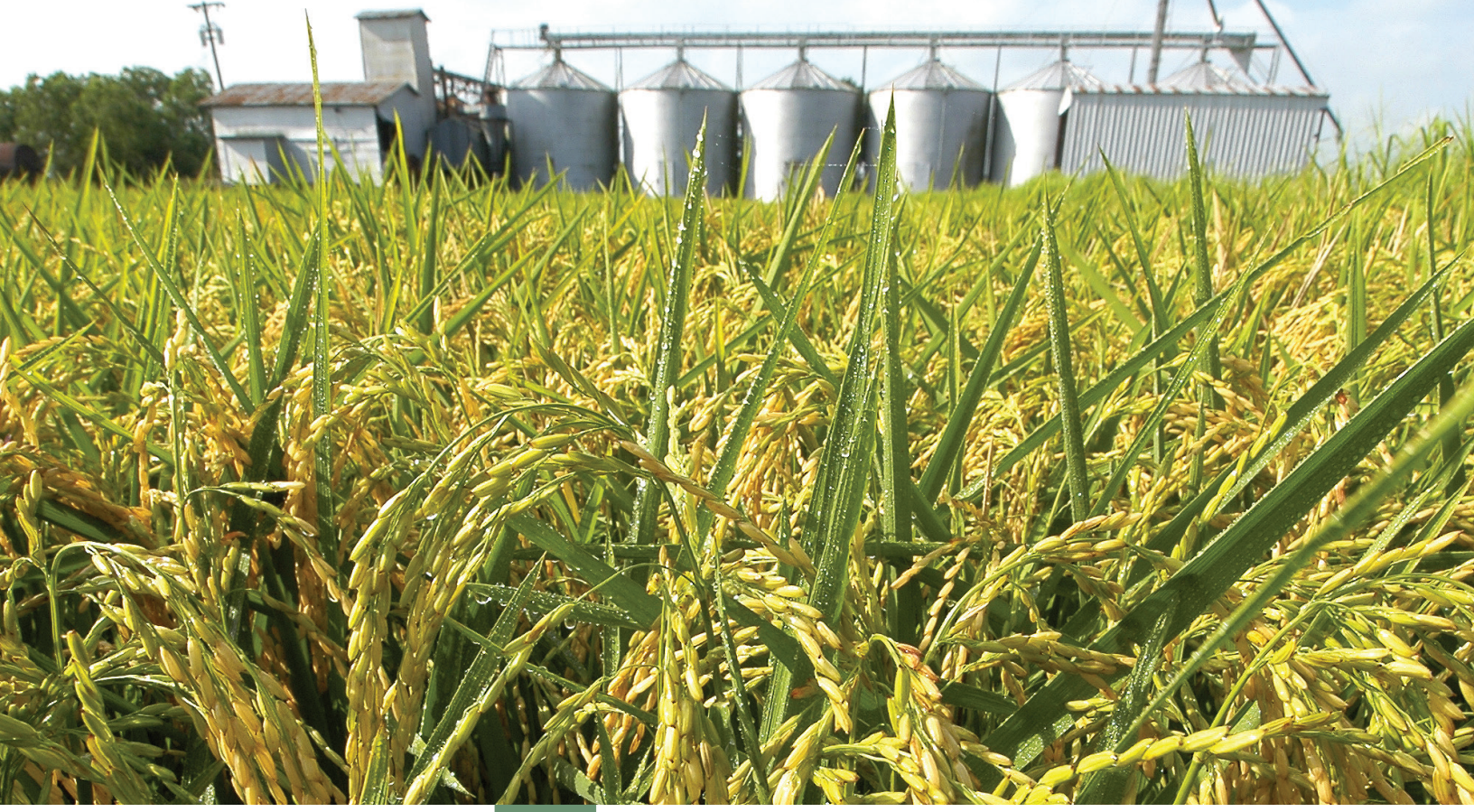
The traditional practice of burning rice fields after harvest in California to dispose of straw and to control disease and pest problems was found to produce pollutants that impacted Central Valley air quality. The rice sector worked collaboratively with the legislature on the passage of a program to reduce the use of this practice between 1990 and 2000, leading to an 80 to 90 percent reduction of the major air pollutants of regulatory concern over the past 30 years. According to the *California Rice Environmental Sustainability Report*, three primary strategies have been employed for managing straw in the post-burn era, leading to improved air quality as follows: incorporating straw into soil with active winter flooding, straw incorporation without active flooding, and harvesting the straw for other use.[29]

Conservation tillage can reduce carbon dioxide emissions in addition to energy use due to fewer tractor passes through the field. Crop residue left in the field reduces carbon dioxide released into the atmosphere as it stores carbon in organic matter, and it improves air quality as it reduces wind erosion and dust in the air.[30]

In addition to optimizing pump efficiencies and water usage, AWD can also improve air quality and mitigate climate impacts. A meta-analysis of data from field studies in the U.S. conducted by a group of scientists from California and the mid-South, led out of University of California-Davis in collaboration with Field to Market, showed that by using AWD, rice farmers can reduce methane emissions between 39 percent with a single drain and 83 percent with multiple drains on average per season.[31]

Arkansas Voluntary Smoke Management Guidelines

To continue the responsible stewardship of our natural resources, nearly a dozen Arkansas agricultural groups met in 2017 to develop a voluntary smoke management program for farmers. Among those were the Arkansas Rice Federation, the Arkansas Agriculture Department, Arkansas Soybean Association, University of Arkansas, and the Arkansas Farm Bureau. The smoke management program is simple. Before burning, farmers are encouraged to call the Agriculture Department Dispatch Center to report their intentions. A recommendation will be made to burn or not to burn based on atmospheric conditions, including wind speeds and humidity levels that are conducive to dissipating the smoke. If the winds are blowing toward a populated area or if too many producers have already registered to burn in an air basin, the dispatch center may recommend against burning that day. The guidelines are all voluntary and are an example of farmers desire to be proactive conservationists.



greenhouse gas emissions

41%

per cwt rice produced

Finally, if best management practices for nitrogen (N) fertilizer application are followed, gaseous losses of N from rice fields in the form of greenhouse gasses can be reduced. Gaseous losses of ammonia (NH_3) gas can occur when urea fertilizer is left exposed on the soil surface. The use of urease inhibitors can slow the breakdown of urea (hydrolysis) and subsequently reduce ammonia volatilization losses from rice fields. Gaseous losses of N can also occur in rice fields through a process called denitrification which converts nitrate-N (NO_3) to nitrite (NO_2), nitric oxide (NO), nitrous oxide (N_2O, a greenhouse gas), and nitrogen gas (N_2) in a series of reactions. The denitrification losses of gaseous N can only occur when N is in the nitrate-N form and when oxygen is not present, which is common for flooded soils, but the use of ammonium and ammonium forming fertilizers, like urea, instead of nitrate-N fertilizers helps prevent these losses. Lastly, urease inhibitors can also help reduce the time that ammonium-N is left exposed, thus decreasing the time for nitrification to occur; reduced nitrate-N in the soil prior to flooding results in decreased losses of the greenhouse gas nitrous oxide from rice fields. It is estimated that the adoption rate of the use of urease inhibitors by rice producers for their pre-flood N application is near 90 percent, resulting in improved environmental outcomes.

Enhancing Biodiversity

Rice conservation practices improve much more than water, soil, and air. They improve and enhance vital wildlife habitat.

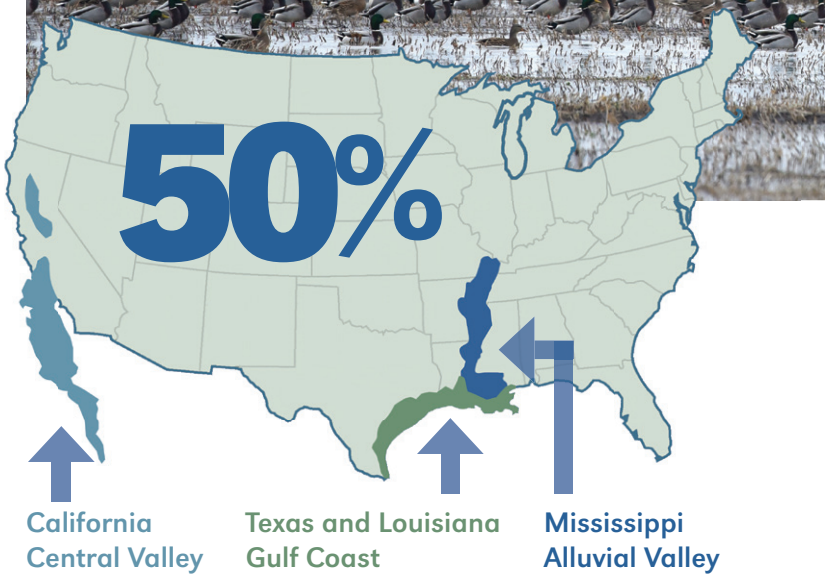
Significant declines in wetlands across the United States over the past 50 years threaten wildlife habitats for migratory and non-migratory birds.[33] Winter flooded rice fields provide a crucial haven and play a critical role in supporting millions of waterfowl each year with both food and habitat. Just beneath the surface of the water and the soil, flooded rice fields also give life to a complex web of crawfish, amphibians, fish, reptiles, microflora, and microfauna.

Enhancing Biodiversity

Foraging waterfowl give back to the land in a variety of ways as they search for feedstuffs in the grain residue left after harvest. Environmental side benefits include improving soil nutrients, increasing straw decomposition rates, reducing pesticide use by reducing pest pressure, and other agronomic advantages. Social and economic benefits for farmers and society include increased recreational and revenue opportunities through viewing and hunting.

The six rice-producing states cover three geographic regions — the Central Valley of California, the Lower Mississippi River Valley, and the Texas and Louisiana Gulf Coast — which overlap with three of the 22 regions targeted in the North American Waterfowl Management Plan (NAWMP) of the U.S. Fish and Wildlife Service (FWS). The NAWMP was put into place in 1986 with a shared plan for restoring waterfowl populations through habitat protection, restoration, and enhancement. Habitat-based joint ventures with public and private organizations were established in each region, including the three most important for wintering habitats: Central Valley Joint Venture (CVJV), the Lower Mississippi Valley Joint Venture (LMVJV), and the Gulf Coast Joint Venture (GCJV). Each region has its own goals and mission but all focus on bird habitat and recognize the importance of rice in feeding migratory bird populations.

Waterfowl conservation has long been a focus of Ducks Unlimited (DU), and with the historic coming together of DU and USA Rice through the Rice Stewardship Partnership in 2013, efforts have further intensified to restore habitats and waterfowl populations while increasing conservation and sustainability on the farm. Through the Regional Conservation Partnership Program (RCPP) of the USDA NRCS, more than $80 million in financial support will be available over the course of a decade to help farmers put more conservation practices into place in support of this endeavor.



More than half of North America's ducks and waterfowl winter in one of these regions — which overlap with virtually all of the rice lands in America.

Table 2.
Estimated capital costs of replacing flooded rice habitats with managed seasonal wetlands

Joint Venture	Restored MSW[a] (acres)	Land Purchase Costs per Acre	Restoration[b] Costs per Acre	Total Cost
CVJV	186,188	$8,000	$3,000	$2,048,068,000
GCJV	266,019	$2,750	$1,800	$1,210,386,450
LMVJV	34,613	$4,000	$1,800	$200,755,400
Total	**486,820**			**$3,459,209,850**

[a] Acres of managed seasonal wetlands that would have to be restored to replace the food energy currently provided by flooded rice habitats.
[b] Includes vendor and staff costs.
Source: Petrie, M., M. Brasher, and D. James. 2014. Estimating the biological and economic contributions that rice habitats make in support of North American Waterfowl. The Rice Foundation, Stuttgart, Arkansas, USA.

Of the close to 3 million total rice acres planted each year, rice farmers manage and pay for approximately 700,000 acres of winter-flooded rice habitats,[34] providing roughly 35 percent of all food energy for ducks and other waterfowl that winter in rice growing areas.[35]

It is estimated that the cost of replacing the food energy currently provided in the six rice-producing states through managed seasonal wetlands maintained by rice farmers would total over $3.5 billion. (See Table 2 for estimated costs in each joint venture region.) With the commitment of farmers, conservationists, public agencies such as FWS and NRCS and other private partners, biodiversity will continue to improve in each of the regions. The three regions combined support more than 110 species of wildlife, including waterfowl, shorebirds, waders, raptors and other birds, reptiles and amphibians, and mammals, along with fish and crustaceans not included in the count.[36]

SUSTAINABILITY IN ACTION:

Al Montna, along with his daughters Nicole Van Vleck and Michelle Vogt, work together to run Montna Farms, located in Dingville, California. The Montna family believes conservation practices are fundamental to the sustainability of the farm for future generations. Al's dedication to agriculture and wildlife resulted in the first ever wildlife-friendly agriculture easement in California. He also embodies the long history and link between ducks and rice. "Profit, people, and planet have always been the backbone of our farming ethic," Al says. "You have to look at the whole: run a sound business, and you can do conservation and help people." Al has been involved with Ducks Unlimited (DU) since the 1960s. "I've been hunting my entire life, particularly waterfowl, so supporting DU just seemed natural," he explained. His strong belief in the connections between farming, the people it feeds, and the opportunities it presents to improve habitat for waterfowl is why he helped create the Rice Stewardship Partnership between USA Rice and DU. He still serves as co-chair today. "The partnership we've formed is one that will benefit waterfowl and other wildlife, rice producers, hunters and American citizens alike," Al said. "We'll work together and build upon our common interests and challenges to sustain waterfowl and rice production on the landscape."

"We'll work together and build upon our common interests and challenges to sustain waterfowl and rice production on the landscape."

— Al Montna, California Rice Farmer

Rice farmers along the Gulf Coast participated in the NRCS Gulf of Mexico Initiative, created in response to the Deepwater Horizon oil spill in 2010. NRCS spent nearly $40 million on projects providing cost-share assistance for farmers to winter flood their fields. Rice fields provide natural filter strips and by using groundwater recovery irrigation systems, farmers were able to push clean water into the Gulf of Mexico. When coastal wetland habitats became damaged by the spill, rice fields were able to provide the clean habitat needed for migratory birds.

Central Valley of California

Today, more than 500,000 acres of California rice fields in the Central Valley are winter homes to upwards of 7 million waterfowl and an additional 300,000 shorebirds.[37] Central to the Pacific Flyway, Sacramento Valley rice farms provide nearly all of the food for migrating ducks and geese in the winter season.

Conservation partners have long recognized the Central Valley's importance for wintering waterfowl. In 2011, rice farmers, the California Rice Commission (CRC), NRCS, Audubon California, Point Blue Conservation Science, and The Nature Conservancy worked with NRCS to create the Waterbird Habitat Enhancement program (WHEP). WHEP helps to sustain production agriculture in the Central Valley while providing wildlife with wetland habitats. NRCS has invested nearly $15 million in WHEP cost-share funding. Then, in 2015, the CRC led efforts through the RCPP for the expansion of WHEP on Central Valley Agriculture Lands. The expanded WHEP program invests an additional $6 million in conservation practices in rice fields that benefit waterfowl and waterbird habitat. Nearly 20,000 rice acres are enrolled in WHEP today.

The California Ricelands Waterbird Foundation also supports rice farmers' conservation practices for waterbird habitats. This industry-led, non-profit organization is a partnership of rice farmers and waterbird conservation groups in California's Sacramento Valley. Rice farmers create dedicated habitat for waterbirds and other wetland-dependent species of wildlife. They also install nesting and roost structures for non-waterbird species such as hawks, eagles, and owls.

Creativity in answering the call to improve biodiversity isn't only for the birds; rice and salmon are another natural pairing. The CRC is supporting a cutting-edge experiment to use winter flooded rice fields as a location to grow out salmon fingerlings before they swim to the ocean. With a team of scientists from the Center for Watershed Sciences at University of California Davis, California Trout, and California Department of Fish and Wildlife supported by a grant from NRCS and from a range of private partners, a $1.4 million project is underway to determine the viability of helping young Chinook salmon grow toward adulthood. While the experiment is only beginning, initial trials using winter flooded rice fields near Sacramento River tributaries for growing out juvenile salmon is promising.

Lower Mississippi Valley

Nearly 2 million acres, or two-thirds, of all rice grown in the U.S. is from the Mississippi Delta and Grand Prairie region, which includes Arkansas, Mississippi, Missouri, and Louisiana—with almost 1.5 million acres grown in Arkansas. This region hosts more than half of all waterfowl that cross the Mississippi and Central Flyways in winter.

Rice farmers working with DU, NRCS, FWS, state conservation agencies, and other partners winter flood more than 460,000 acres each year in this region. With the significant loss of wetlands across southern and western states, the winter habitat of flooded rice fields is essential for the waterfowl population.

Third generation Arkansas farmer George Dunklin knows well the importance of winter flooding. "In many important wintering areas such as the Grand Prairie of Arkansas, waterfowl have adapted well to feeding in rice fields after natural grasslands, wetlands, and bottomlands were lost through development," Dunklin says. "This habitat is especially important in

SUSTAINABILITY IN ACTION:

Rice and crawfish are a perfect pair in the fields of Louisiana and are staple cuisines on the plate. The Durand brothers began farming in the 1970s with their father, starting with crawfish and adding rice to their operation in 1980. Today, Jeff, C.J., and Greg Durand work closely with USDA's NRCS and other partners to implement conservation practices that benefit wildlife habitats on their farm. Through financial assistance provided by the Migratory Bird Habitat Initiative (MBHI), the family worked with NRCS, USA Rice, and Ducks Unlimited to develop and maintain wildlife habitat. That habitat has attracted more than 250 different bird species to the Durand farm.

the fall and during dry winters, when natural wetland habitat can be in short supply. At these times, flooded rice fields provide the majority of the wetland habitat that is available for waterfowl and other wildlife in many areas."[38]

The USA Rice-DU Rice Stewardship Partnership is a primary financial resource for wetland conservation efforts of rice farmers in this region. Cost-share opportunities through the NRCS RCPP are available to aid rice farmers in continued implementation of conservation practices through programs like the NRCS Environmental Quality Incentives Program (EQIP) to assist in funding waterfowl habitat growth and restoration.

Missouri rice farmer Rance Daniels farms between 1,500 and 2,000 acres of rice annually. Planting begins in late March and early April. The fields are flooded for optimum rice growth, then drained by early August for a late summer harvest. After the harvest, migratory waterfowl find both food and cover in the rice fields. "In the winter, we flood the fields back up for ducks and waterfowl," Daniels said. "It's a big conservation benefit. The birds get about a third to a half of their food from these flooded rice fields."

SUSTAINABILITY IN ACTION:

Mississippi farmer Curtis Berry farms 5,500 acres, including 4,300 acres of rice. His farming practices conserve water and soil, and provide wildlife habitat. Curtis's father, Charles, is one of the founding fathers of the Delta Wildlife Foundation (DWF). The Berry farm is a model farm for DWF, demonstrating what farmers in the Mississippi Delta are doing to provide wildlife habitat while being good stewards of the water and soil.

Curtis began using zero-grade land leveling about five years ago. "Zero grading makes it easy to maintain the flood during the winter, and it makes better use of the time and labor in the springtime — I don't have to spend a lot of time pulling levees. With zero grade, I use about a third of the water that I would on a straight levee or conventional levee field." Keeping water on the field after harvest attracts ducks and other waterfowl, which also brings in revenue from hunting. Curtis has also removed odd-shaped corners and edges from rice production providing food for wildlife and more efficient use of farm land.

To flood his fields, Curtis mainly uses water from a tailwater reservoir he built in his fields. The reservoir reduces the farm's dependence on groundwater and reuses as much surface water as possible. The Berry Farm participated in NRCS' EQIP program, which provided cost-share support to build the reservoir.

Louisiana also produces 90 percent of the nation's crawfish with flooded rice fields providing the perfect, low-maintenance habitat.

BirdReturns

Born of a partnership between rice farmers, the California Rice Commission, and The Nature Conservancy, the BirdReturns program provides wetland habitat on farm fields to benefit migratory birds. This first-ever market-based conservation program uses a reverse-auction process that allows rice growers to submit bids for the opportunity to install conservation practices. An early adopter of BirdReturns, rice farmer Michael Bosworth has helped shape BirdReturns into the success it is today. Since 2014, more than 60 farms have enrolled in the program for conservation practices on 20,000 acres of land.

These acres support over 200,000 birds representing more than 50 different species. BirdReturns uses science and technology to pinpoint where and when habitat is needed most. The program's habitat management practices are then integrated with planting, harvest, and straw decomposition on rice fields so growers can provide critical habitat while still growing rice.

Michael has enrolled more than 4,000 acres in BirdReturns. He applies precision water management, data-driven fertilizer and herbicide applications, and the use of Field-to-Market's Fieldprint® Calculator for precise habitat management. His conservation practices result in high bird populations using his fields for food. Additionally, Michael dedicates 120 acres of land to permanent wetland for wildlife species that require a wetland habitat all year round.

In Stuttgart, Arkansas, rice farmer Matthew Feilke also uses a variety of conservation practices including winter flooding. After harvesting his crops, Matthew floods his rice fields to create habitat for overwintering waterfowl. The birds have plenty of food and a place to rest on their migration south during the winter months. Winter flooding also helps Matthew's production in the fields by decomposing the straw and stubble from the previous year's crop.

Gulf Coast

Gulf Coast rice fields of Texas and Louisiana are rich in grain, natural seeds, and a variety of bugs, providing vital food resources for wintering waterfowl. Some lands are also used for crawfish aquaculture. The Gulf Coast Joint Venture seeks to conserve enough habitat to support some 13.7 million ducks and 1.6 million geese — roughly 20 percent of the wintering waterfowl in the United States.[39]

Gulf Coast conservation and restoration of coastal habitats continues to improve through the collaborative work of rice farmers, DU, NRCS, FWS, and state and other conservation partners in the region. Conservation partners support private landowners' installation of conservation structures that help control erosion, improve water-management capabilities, and provide habitat for wintering waterfowl in rice fields. In the Louisiana Waterfowl Project — South, a joint venture program, more than 26,600 acres of high-quality habitat for wintering waterfowl and other wetland-dependent birds has been restored and enhanced since the projects' inception in 1999.[40] The Texas Prairie Wetland Project (TPWP) is another joint venture effort focused on restoring, enhancing, and creating shallow wetlands, resulting in more than 80,000 acres of waterfowl habitat along 28 counties of the Texas Gulf Coast since 1991.[41] Additionally, two RCPP projects in Texas, the Prairie Conservation Reservoir project approved in 2017 and the Gulf Coast Water and Wildlife RCPP approved in 2018 will both support enhanced biodiversity in rice-producing regions.

Rice farming has been in the family for more than 100 years for Linda and L.G. Raun in El Campo, a small town off the Texas Gulf Coast. Linda's great grandfather helped bring the rice industry to Texas, and L.G. is a third-generation farmer after his father and grandfather who planted the Raun family's first rice crop in 1915. The Rauns have been filling their harvested rice field with water for roosting waterfowl that feed on the residual rice seeds in the surrounding fields. As L.G. says, "the more acres we grow, the more the wildlife benefits."

Preserving wildlife habitats along the Gulf Coast also supports state and local economies. In addition to waterfowl contributions, Louisiana also produces 90 percent of the nation's crawfish with flooded rice fields providing the perfect, low-maintenance habitat.

Yellow Rails and Rice Festival

Every November, birders, researchers, and wildlife conservationists from around the world converge on rice fields in southern Louisiana to witness the annual migration of the elusive Yellow Rail marsh bird. The Yellow Rails and Rice Festival recognizes the value of the rice wetlands for waterfowl and wildlife habitats.

The elusive Yellow Rail is at the top of birdwatching lists. It lives in the underbrush of marshy fields, feeding on insects, snails, and vegetation. It is so elusive that even scientists at the Louisiana State University Museum of Natural Science, who know the species better than anyone, aren't sure where it winters. Ornithologists believe the Yellow Rail spends the cold months somewhere further south, in the brackish salt marshes of coastal Texas.

Thornwell, Louisiana, is known as the Yellow Rail Capital of the World. Rice fields like Kevin Berken's are an essential pit stop for migratory birds. Because the Yellow Rail's fall arrival coincides with the late fall ratoon crop rice harvest, rice fields present a unique opportunity to see these little birds in action.

About 10 years ago, Shirley and Kevin Berken, along with Steve Cardiff, and Donna Dittman (both ornithologists at the Louisiana State University Museum of Natural Science), founded the Yellow Rails and Rice Festival. The goal was to show how rice fields provide valuable habitat to many coastal animals while showcasing this rare species, bringing rice farmers and wildlife conservationists together on common ground.

Kevin conducts an orientation session he calls "Rice Farming 101" for the birders. He explains what they will directly see in the fields, but also explains the conservation practices they may not see. He explains the basics of the rice industry and conducts a Q&A session, so participants can learn why rice farms are so important to birds and humans alike. Next, Kevin takes birdwatchers out into the fields on his combine. Participants see the rails take flight or scurry into a net, where wildlife experts give a hands-on demonstration of how to band the rail's leg. Being as rare and elusive as it is, the Yellow Rail is a perfect candidate for cutting-edge research initiatives.

In 2017, 120 participants, representing 30 states and four countries, attended the Yellow Rails and Rice festival. Festival co-founder Shirley Berken says, "Visitors leave with memories not only of their "lifer" Yellow Rail, but how much they enjoyed a broader Louisiana experience — visiting local museums, feasting on regional delicacies, even being serenaded by a Cajun band."

Investing in Long-Term Sustainability

Rice farmers' commitment to voluntary sustainability practices dates back generations. Practices such as precision water use, conservation tillage, and winter flooding have only improved over time and through advances in technology. The data clearly show the hard work of rice farmers is making significant positive impacts on the environment. Soil is preserved. Water is efficiently used. Air is cleaner. Wildlife habitat is increasing.

Recognizing this success, conservation organizations and corporate partners are investing in the future of long-term rice sustainability through collaborative programs and other supply chain initiatives.

Public Partnership

The USDA Natural Resources Conservation Service (NRCS) invests funds on behalf of the public trust in conservation practices. These practices are implemented through NRCS programs like the Conservation Stewardship Program (CSP), the Environmental Quality Incentives Program (EQIP), and the Regional Conservation Partnership Program (RCPP).

CSP provides financial incentives to farmers and ranchers who are already implementing conservation practices on their land and want to enhance those practices with NRCS approved conservation enhancements. CSP allows a producer to keep their land in production while also providing a conservation benefit, making it an appealing program for many producers.

EQIP is also available for working agricultural lands and was specifically created to help farmers and ranchers with larger infrastructure projects that, once completed, will provide a significant benefit for the conservation of soil, water, air quality, and other natural resources. Along with financial cost-share for these projects, NRCS provides one-on-one technical assistance to producers for planning and implanting these projects.

RCPP was created in the 2014 Farm Bill and provides a unique opportunity for NRCS to partner with organizations such as state and local government, tribes, non-profits, private industry, water districts, and universities. These partnerships multiply the reach and impact of NRCS funds by focusing funds on a critical conservation need in a state, critical conservation area, or in multiple states by requiring the partnering organization to match NRCS dollar for dollar in investment.

Rice farmers utilize more than 50 conservation practices across the six rice-producing states, ranging from land forming and leveling to construction of irrigation ditches, drains, and

SUSTAINABILITY IN ACTION AND NRCS ON THE GROUND:

Timothy Gertson and his cousin Daniel Gertson are fifth-generation farmers who own and operate G5 Farms. The Gertsons' passion for conservation was passed down to them from their fathers, so it was no surprise when Timothy secured his first NRCS EQIP contract in 2010, just a year into farming. He used this cost-share program to install more than four miles of 16-inch underground pipeline to replace irrigation canals, resulting in up to 20 percent less water needed to grow his crop. He secured a second EQIP contract and began precision land-leveling, which provided an additional 10-20 percent irrigation water savings. By using this cost-share program NRCS helps shoulder some of the financial risk associated with large projects and new practices. After Timothy saw the financial returns and water savings of implementing conservation practices, he decided to do more of it—this time taking on all the financial risk himself.

NRCS Rice Conservation Investment, 2010 – 2018

	CSP	EQIP	Total
Conventional Contracts	$319,367,101	$197,639,898	$517,006,999
RCPP Contracts	$4,031,689	$20,593,939	$24,625,628
Total	**$323,398,790**	**$218,233,837**	**$541,632,627**

$540 million
spent on conservation practices and enhancements

Rice farmers and millers share a commitment to improving sustainability in the agriculture and food supply chain...

"A coming together of two organizations that share such a close passion for conservation, working rice lands, and the issues facing rice farmers throughout the nation is a testament to what can be accomplished when two groups have such closely combined goals."

— Al Montna, California Rice Farmer and Rice Stewardship Partnership co-chair

reservoirs. Over $540 million has been invested from 2010 to 2018 on conservation practices on rice lands and enhancements to address environmental concerns, with an additional farmer investment ranging from approximately $150-200 million in cost-share funding for EQIP. RCPP funding reflects contracts since program inception in 2016.

Rice Stewardship Partnership

USA Rice and Ducks Unlimited (DU) formed the Rice Stewardship Partnership (the Partnership) in 2013. Through this unique partnership, public and private resources will be leveraged to positively impact over 700,000 acres of working rice lands. California rice famer Al Montna was deeply involved in the creation of this partnership and still serves as co-chair today, along with Louisiana rice farmer, Jeff Durand. "This coming together of two organizations that share such a close passion for conservation, working rice lands, and the issues facing rice farmers throughout the nation is a testament to what can be accomplished when two groups have such closely aligned goals," says Montna.

The Partnership was awarded its first RCPP grant of $10 million in 2014 to accelerate adoption of conservation practices and help farmers calculate the environmental benefits by using the Field to Market Fieldprint® Calculator. The Rice Stewardship Partnership is now implementing a total of eight rice-focused regional RCPP projects through 2023, bringing more than $80 million to rice farmers for the implementation of conservation practices. This is possible through financial incentive and cost-share funding programs such as NRCS EQIP and CSP, along with technical assistance from Partnership staff.

Quantifying Sustainability

One of the tools used to track resource inputs and savings through Rice Stewardship efforts is the Fieldprint® Platform. Designed by Field to Market:TheAllianceforSustainableAgriculture, the platform is an online application that allows producers to benchmark their farm's sustainability performance against as many as eight sustainability indicators, including land use, soil conservation, soil carbon, irrigation water use, energy use, greenhouse gas emissions, biodiversity, and water quality. Producers input on-farm and production data, and the Fieldprint® Platform provides data and analyzed feedback in return.

For Rice Stewardship sponsors like the NRCS, the Fieldprint® Platform provides a first-year baseline from which to work. In subsequent years, it can determine what impact conservation practices have on resources. Ultimately, this will help ensure that sustainability practices continue achieving the desired improvements. So far, data from more than 42,000 acres on 133 farms in Arkansas, Louisiana, Mississippi, and Texas have been input into the Fieldprint® Calculator through the Rice Stewardship Partnership programs.

Investing in Long-Term Sustainability

The Partnership also works with more than 40 organizations and corporate partners. In addition to corporate partners providing direct financial support, close to 100 private partners are providing in-kind support for technical assistance. The work the Rice Stewardship Partnership does on the ground with farmers would not be possible without this support.

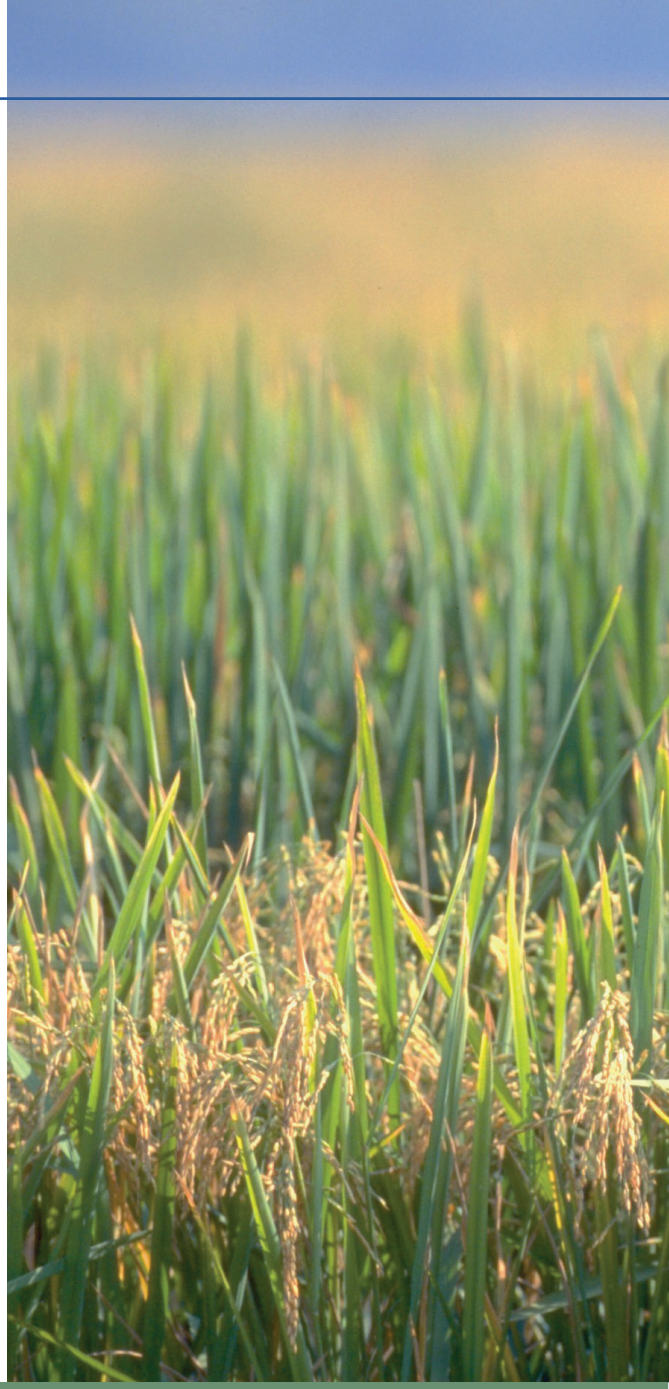
One focus of these projects has been increasing young farmer participation. According to national data, only eight percent of the primary operators on rice farms are young farmers; however, through targeted efforts, 22 percent of the Rice Stewardship Partnership program participants are young farmers.

Thanks to the Stewardship Partnership's efforts, alternate wetting and drying has been implemented on 27,000 acres to date. Additionally, water quality evaluations in Louisiana have measured the positive improvements in water leaving the rice field. The Rice Stewardship Partnership was an unprecedented collaboration at the time of its formation and continues to seek opportunities to positively affect working rice lands for the benefit of the environment and wildlife.

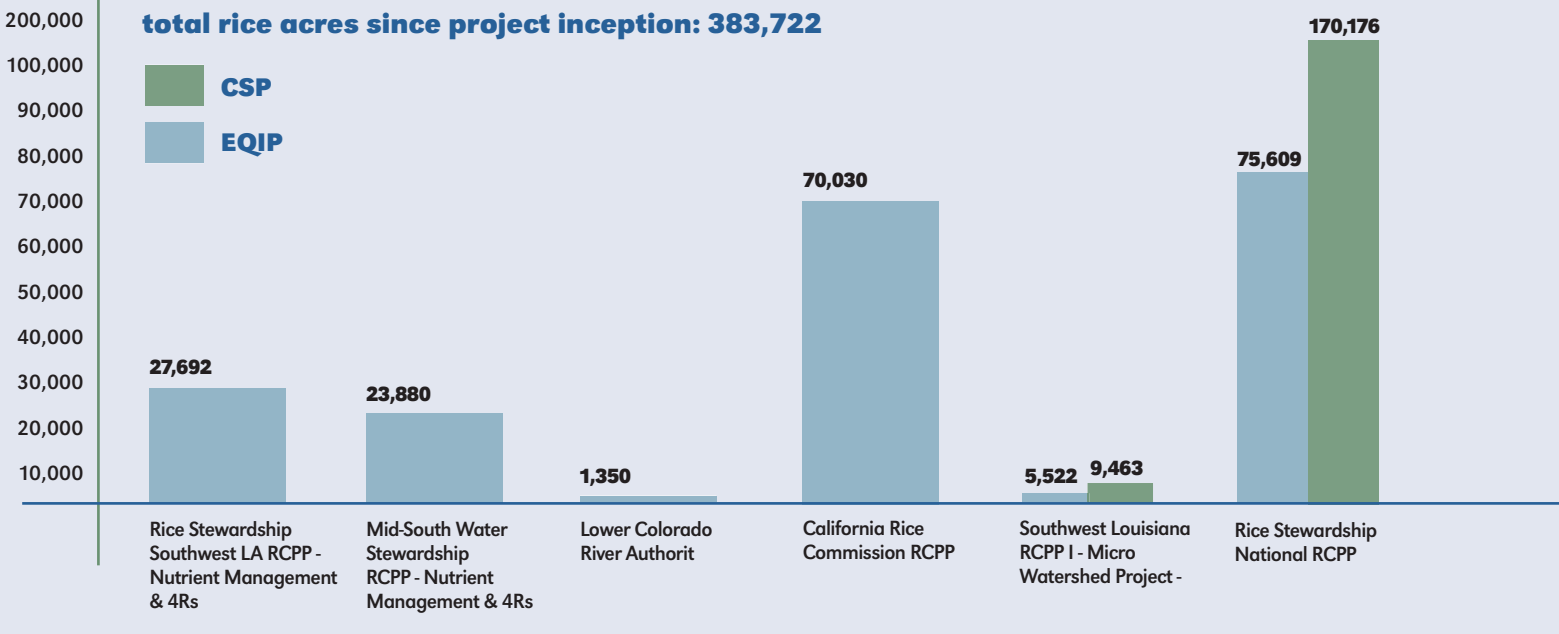
Working Towards Common Goals with Supply Chain Partners

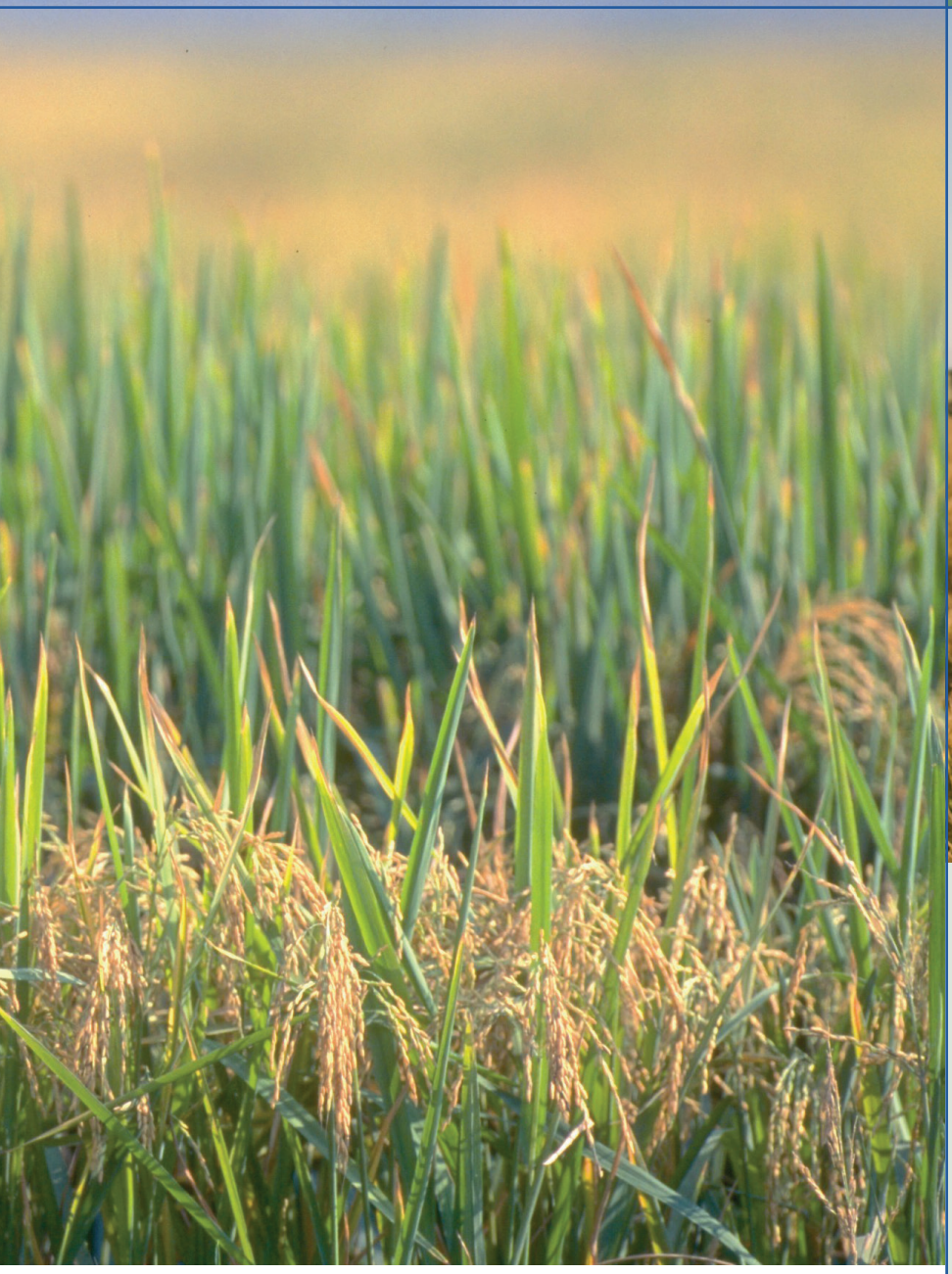
Rice farmers and millers share a commitment to improving sustainability in the agriculture and food supply chain with other partners throughout the industry. Multiple supply chain initiatives are underway, involving farmers and mills in projects of various size and scope.

The unique structure of USA Rice and its existing cohesive working relationship between farmers, millers, merchants, and other stakeholders has enabled the U.S. rice industry to come together through its Sustainability Committee to work on common goals moving rice sustainability forward.



The Rice Stewardship Partnership





In addition to the significant Field to Market project through the RCPP, two large Fieldprint® Calculator projects are ongoing in Arkansas and Louisiana, involving famers and mills working with a leading input supplier and food company. Field to Market has worked collaboratively with other global sustainability platforms that has allowed a major consumer packaged goods company to work more efficiently with farmers and mills in their value chain to measure sustainability.

Field to Market is a diverse alliance working to create opportunities across the agricultural supply chain for continuous improvements in productivity, environmental quality, and human well-being. USA Rice has been a long-term partner of Field to Market and is actively involved in the development of a rice-specific Fieldprint® Calculator that shows growers their operation's scorecard on the sustainability index. By making sure rice farmers are at the table, USA Rice can ensure supply chain goals are realistic and accurate.

SUSTAINABILITY IN ACTION: FARMER LEADERSHIP

Sustainability has long been a commitment for Leo LaGrande, a partner in SB&L LaGrande in Williams, California. A third-generation farmer, Leo's long-term contributions include nearly a decade as chair of the USA Rice Conservation Committee, and, in that capacity, he helped to establish the Rice Stewardship Partnership, bringing together multiple partners in conservation and sustainability.

Leo understands the importance of conservation on the farm and participates in programs such as the CSP on his own operation. He also realizes the importance of building up the next generation and is extremely active in cultivating young rice leaders, including regularly speaking to participants in the Rice Leadership Development Program of the Rice Foundation.

As Leo says, "It's vital we continue to protect our environment and provide every opportunity for future generations in rice. These are investments with widespread benefit to our food, farms, communities, and wildlife."

Supporting Economies and Creating Jobs

Sustainability extends beyond environmental resource impacts. To ensure good environmental practices continue, farm operation must be economically sustainable. Rice, an economic powerhouse, improves on-farm profitability, supports and sustains local communities, and significantly contributes to the U.S. economy. In many cases, community life revolves around rice as the main economic resource, supporting entire towns.

Nearly 85 percent of the rice consumed in the United States is U.S. grown on family farms across the six major rice-producing states: Arkansas, California, Louisiana, Mississippi, Missouri, and Texas. As cited in *Economic Contributions of the U.S. Rice Milling Sector to the U.S. Economy*, from 2014 to 2016, the U.S. total rice planted acreage averaged 2.91 million acres with approximately 2.8 million harvested acres, and total rice production over this period ranged from 193.15 million cwt in 2015 to 224.15 million cwt in 2016.

On the Farm

Rice farmers naturally strive for the most productive and cost-efficient practices possible to improve their bottom line, and if the conservation practice doesn't pay its way on the farm, it's not sustainable. Practices such as alternate wetting and drying (AWD), multiple inlet flooding, tailwater recovery systems, automated water pump and monitoring systems, and alternative energy sources all contribute to economic sustainability on the farm and in the mill. Over time, these systems will pay for themselves in savings, and NRCS provides cost-share assistance to offset some of the start up cost. Investing in alternative energy sources such as solar panels can reduce electricity costs and contribute to the bottom line.

The total farmgate value of rice production in 2015 was $2.42 billion.[42] The total economic output effect, combining direct, indirect and induced effects, of rice production is estimated at $5.65 billion for 2015 as summarized in Table 3. On average, each rice farm contributes $1 million to the local economy.[43] Rice farmers and surrounding communities further benefit from increased income and local economic activity through wildlife recreational sports made possible by rice farms. According to the U.S. Fish and Wildlife Service (FWS), wildlife viewing expenditures nationwide totaled more than $75 billion in 2016. Nationwide, duck hunting generates as much as $4.2 billion anually and supports more than 34,000 U.S. jobs annually and mainly in rural areas.[44]

Table 3.
Economic Contributions of Rice Production for 2015

Total	Output ($s)	Employment (#)	Labor Income ($s)	Total Value Added ($s)
Direct Effect	3,186,972,914	14,642	1,558,326,870	1,861,059,763
Indirect Effect	994,346,581	6,372	305,706,635	535,633,771
Induced Effect	1,465,721,674	10,696	459,499,612	843,707,305
Total Effect	**5,647,041,169**	**31,710**	**2,323,533,118**	**3,240,400,839**

NOTE: Elements of Labor Income are included in the Total Value Added column as well as value added in the Output column. These values should not be summed to determine total economic contribution since double-counting would occur. However, the numbers reflect the breadth and enormous impact of the economic contributions of the rice industry and related activities.

- Value Added represents total wages and salaries of an industry, plus value of buying inputs and production products in farming and associated economic activities in milling. Output is a measure representative of the goods and services produced.
- Direct effects are directly attributable to the farming or milling operation; Indirect Effects are related to the economy of businesses supplying the industry; and Induced Effects represent the economic activity and expenditures by employees of the industry and associated suppliers.

Source: "Economic Contributions of US Rice Production to the US Economy," by James W. Richardson and Joe L. Outlaw, February 2017, Agricultural and Food Policy Center, Texas A&M University, *Research Report 17-2*, p. 7.

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At the Mill

Rice milling operations provide a necessary link from farm to table. After harvest of the rice crop it is considered rough rice (or paddy rice). For it to be consumed, rice must be milled to remove the hull. At this point it is considered brown rice which is preferred by many consumers for the fiber and nutrient content in the bran layer. White rice is the product of removing the bran layer and endosperm through further milling. Brown or white rice can then be sold for consumer use or for processed foods, brewing, or by-products like rice flour and rice bran oil. From 2014–2016, the average annual product shipment value, including milled rice and by-products, was $3.79 billion.

Rice milling operations constitute a very significant sector of the U.S. rice industry, with $9.34 billion in total output value of goods and services in 2016. This figure is the combined direct, indirect, and induced effects of rice milling, and indicates the value of goods and services associated with the demand for milled rice end products and by-products. Table 4 summarizes labor and value added.[45]

Rice and the National Economy

In addition to the economic contributions to the U.S. from rice farming and rice milling, rice must be moved from mills into the domestic wholesale and retail markets. The economic contributions of these forward market linkages, such as transportation and trade, have also been estimated. As shown in Table 5, the total economic output of rice milling operations and forward market linkages is $12.83 billion to the U.S. economy.

Table 4.
Net Economic Contribution of U.S. Rice Milling Operations on the U.S. Economy for 2016

Impact Type	Labor Income ($1,000)	Value Added ($1,000)	Output ($1,000)
Direct Effect	172,006	276,127	1,982,896
Indirect Effect	808,934	1,261,173	3,827,716
Induced Effect	1,250,307	2,077,369	3,530,944
Total Effect	**2,231,247**	**3,714,669**	**9,341,556**

Table 5.
Summary of Contribution of Rice Milling Operations and Forward Market Linkages on the U.S. Economy

Impact Type	Labor Income ($1,000)	Value Added ($1,000)	Output ($1,000)
Direct Effect	568,568	901,127	2,946,437
Indirect Effect	981,489	1,661,722	4,357,893
Induced Effect	1,959,631	3,253,277	5,528,969
Total Effect	**3,509,688**	**5,816,126**	**12,833,299**

Table 4 and 5 Source: "Economic Contributions of the U.S. Rice Milling Sector to the U.S. Economy," by Michael E. Salassi and J. Matthew Fannin, August 2018, Louisiana State University Agricultural Center, *Agricultural Economics Staff Report No. 2018 35*, P. 8.

Rice is the primary dietary staple for more than half the world's population.

50%
annual rice crop exported

Rice and Jobs in the United States

The U.S. rice industry provides critical jobs in rural areas throughout the country. Across the U.S., 5,563 rice farmers directly support 14,642 jobs, generating $1.56 billion in direct labor income. U.S. rice mills supported an annual average employment of 4,819 people and provided over $245 million in wages.[48] Average wages for employees on farms and in mills exceed minimum wage in all rice producing states.

Organic or Conventional?

With the increasing demand for organic products, acreage for organic rice has also increased six-fold in the past 20 years. The market offers a premium for organic, and the question that many are asking is, "What rice production system is more sustainable, organic or conventional?"

The temptation to claim a sustainability hierarchy is great for advocates of both production systems. For example, reduced pesticide use may lessen one's environmental impact in organic systems but may be offset by increased water use for weed control. Advances in AWD in conventional systems may reduce water usage and greenhouse gas emissions but may increase pesticide use. While each system has its attributes, the key to advancing sustainability is in advancing continuous improvement for both systems. Research investments continue to make both organic and conventional rice more economically and agronomically sustainable.

Every business in Stuttgart is connected to rice in some way. The rice industry supports industries like transportation, steel, and food. Trucking and rail industries connect Stuttgart rice with the rest of the country.

The rice industry also includes input suppliers and others whose businesses are dependent on rice farms and mills. This means that in addition to their direct employees, rice farms supported 31,710 jobs in 2017, with $2.32 billion in labor income.[49] Numbers are not available for employment beyond the mill itself, but indirectly, many more jobs are provided throughout the industry for trade and transportation and through forward market linkages in wholesale and retail.

Global Economy

Rice is the primary dietary staple for more than half the world's population. Increasingly, buyers are looking for strong relationships with producers who use sustainability practices. The United States ranks fifth among rice exporting countries, exporting about 50% of the annual rice crop to more than 120 countries around the globe and accounting for roughly 8 percent of the world's exports.[50]

SUSTAINABILITY IN ACTION: COMMUNITIES

In Stuttgart, Arkansas, rice is truly the economic engine of the town, providing jobs, building the community, and sustaining the local economy. With a population of around 9,000, most people in "The Rice and Duck Capital of the World" are employed either directly or indirectly by the rice industry. "Three rice mills employ over 2,000 people. Nearly one person in every family in Stuttgart is involved with the rice mills in some way," says Carl Brothers, former Senior Vice President and Chief Operating Officer of Riceland Foods.

Every business in Stuttgart is connected to rice in some way. The rice industry supports industries like transportation, steel, and food. Trucking and rail industries connect Stuttgart rice with the rest of the country.

Every November, ducks and hunters alike descend upon Stuttgart, host to the World Championship Duck Calling Contest. The contest dates back to 1936 in connection with the annual Arkansas Rice Carnival, and drew nearly 40,000 people from all over the world in 2017, generating revenue from food and lodging, local attractions, and transportation. The entire 60-day duck season can bring up to $1 million per day to Stuttgart.[46]

Stuttgart also houses the University of Arkansas Rice Research and Extension Center. This facility was established in 1925 by a group of rice farmers who recognized the need for research-based information to address specific production problems. Research studies include plant breeding, agronomy, soil science, pathology, entomology, physiology, and economics. Working with farmers in Stuttgart and the surrounding rice-producing region, the Ag Extension service studies best practices for crop and commodity production. All rice producing states have similar research and Extension efforts to facilitate development and implementation of technological advances in rice production and processing.

With a population of more than 9,000, most people in "The Rice and Duck Capitol of the World" are employed either directly or indirectly by the rice industry.

Producing a Safe and Sustainable Food Supply

U.S. laws and regulations ensure a safe food supply and encourage conservation practices that improve the environment. Rice farmers are expected to comply with all food, labor, and worker safety federal and state laws and regulations. Farmers also adhere to — and often exceed — strict U.S. environmental standards. A summary of these laws and regulations follows.

The Farm Bill: Provides risk management provisions and tools, such as commodity support programs and conservation cost-share and incentive-based working lands programs that assist farmers in adopting conservation practices.

Clean Water Act: Establishes the basic structure for regulating discharges of pollutants into waters. Authorizes the U.S. Environmental Protection Agency (EPA) to regulate point and non-point sources of pollution.

Clean Air Act: This comprehensive federal law regulates air emissions from area, stationary, and mobile sources. Authorizes EPA to establish National Ambient Air Quality Standards to protect public health and welfare, and to regulate emissions of hazardous air pollutants.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA): Provides EPA oversight of pesticide distribution, sale, and use. EPA rigorously evaluates the environmental and health effects of all pesticide products before they can be sold in the U.S. Pesticide product labels are legally enforceable and include directions from EPA on application rates and timing, proper use, and precautions. FIFRA also requires pesticide users to complete training to obtain a license as a pesticide applicator. Pesticide applicator licensing is administered at the state level.

Food Quality Protection Act (FQPA): This amendment to FIFRA created stricter safety standards for EPA's evaluation of pesticides, especially to ensure safety for infants and children.

Endangered Species Act (ESA): Provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. By law, the EPA can issue emergency suspensions of certain pesticides to cancel or restrict their use if an endangered species will be adversely affected.

Safe Drinking Water Act (SDWA): Protects the quality of drinking water in the U.S., focusing on all waters actually or potentially designed for drinking use, whether from above or underground sources.

Food Safety Modernization Act (FSMA): Requires that food facilities implement and monitor effective measures to prevent contamination and to have a plan to take corrective actions if needed.

Federal Food, Drug, and Cosmetic Act (FFDCA): This set of laws authorizes the Food and Drug Administration (FDA) to oversee the safety of food, drugs, and cosmetics.

Occupational Safety and Health Act (OSHA): Ensures worker and workplace safety. Employers must provide their workers a place of employment free from recognized hazards to safety and health, such as exposure to toxic chemicals, excessive noise levels, mechanical dangers, heat or cold stress, and unsanitary conditions. Agricultural workers are covered by many of the regulations generated by OSHA and/or by state agencies that are approved for self-regulation under OSHA.

Worker Protection Standards (WPS): Establishes requirements to inform agricultural workers and handlers about pesticide safety, protect from potential exposure, and mitigate exposures that may occur. Requires all workers receive basic pesticide safety training, protective equipment, restricted entry intervals, decontamination supplies, and medical assistance in emergency.

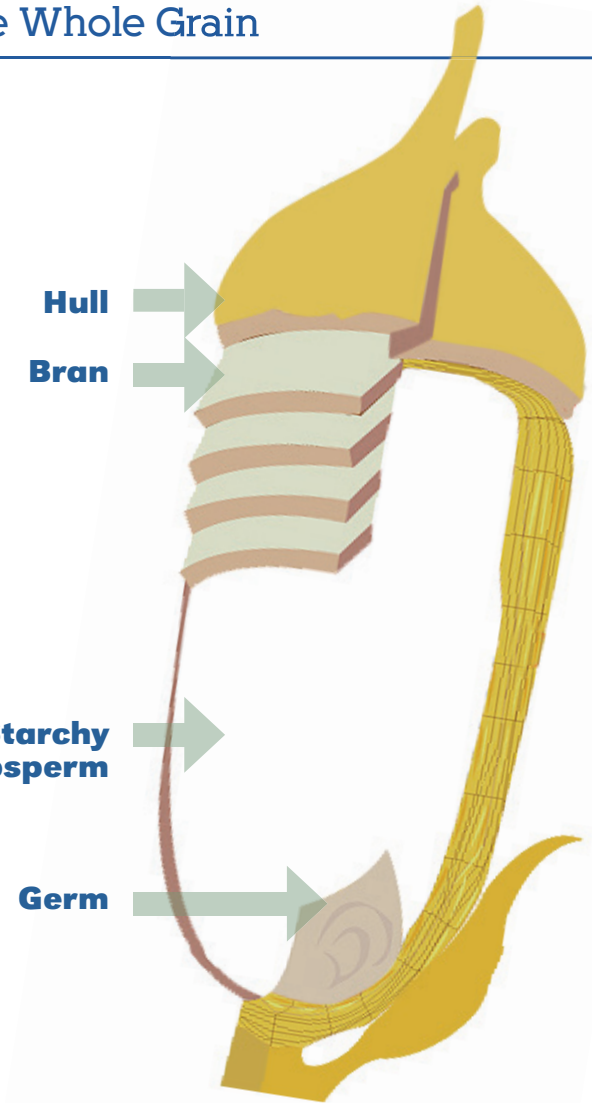
Fair Labor Standards Act (FLSA): Establishes minimum wage, overtime pay, recordkeeping, and youth employment standards affecting employees in the private sector and in Federal, State, and local governments.

"Rice farmers and millers must comply with thousands of pages of federal and state regulations that are strictly enforced. This paired with the industry's commitment to conservation makes U.S.-grown rice the most sustainably produced in the world."

— Betsy Ward, President and CEO, USA Rice

The Whole Grain

This small, multi-purpose grain packs enormous benefits with a variety of uses. With high consumption rates throughout the world, what happens to the waste created by the hull, bran and germ layers that are removed at the mill? As it turns out, those waste materials aren't really waste at all.



Rice is a dietary staple for half the world's population. Not only is both white and whole grain brown rice an enjoyable food for human consumption used widely in a variety of cuisines, it is also recognized for its important role in feeding hungry people and addressing food insecurity issues, both locally and world-wide.

Straight from the field, each grain of rice is enclosed in a tough outer hull, which must be removed before consumer consumption. Just below the hull are the bran and germ layers, which are high in vitamins, minerals, oil, and various phytonutrients. Rice at this stage is 100 percent whole grain. Further processing removes all the outer layers to get to the endosperm, or white rice.

Separate from whole grain rice, the bran has been found to have other uses as well. Many mills extract the oil from the bran and sell rice bran oil as a co-product. The fiber and nutrient-rich rice bran also makes a great additive for smoothies and cereals.

Baking with Rice

When finely ground, brown or white rice provide a gluten-free baking option. Rice flour is rich in carbohydrates and low in fat. Many consumers use rice flour in baking cakes, cookies, dumplings, breads and more, as well as thickening sauces and coating fish and other proteins. Rice bran oil is also used in commercial baked goods and meal replacement bars for its high nutritional content and healthy fats.

The Nutritional Power of Rice

The tiny but mighty rice grain is nutrient-rich, supplying energy, complex carbohydrates, protein, fiber, beneficial antioxidants, and more than 15 vitamins and minerals.

Here's the Scoop on U.S. Grown Rice:

- **It's a "hundred calorie pack":** one serving of rice contains only 100 calories

- **It's a "free" food:** naturally sodium-, cholesterol-, gluten- and GMO-free

- **Rice packs a nutritional punch:** it provides more than 15 essential vitamins and minerals including, folic acid, B vitamins, potassium, magnesium, selenium, fiber, iron and zinc

- **Whole grain goodness:** one serving of brown, wild, red, or black rice provides two of the three recommended daily servings of whole grains

The Household Whole Grain

Rice isn't just for eating, even beginning chefs appreciate rice for its easy versatility of flavor creations. But how about other household uses? Since rice absorbs moisture, it can save electronics from drowning and even keep hardware tools from being rusty. Enjoy a homemade heating pad for sore muscles with rice and a few drops of lavender sewed into a bag, then heated in the microwave. Clean coffee grinders or small containers with rice.

Brewing with Rice

Traditionally, barley is thought of as the go-to grain for brewing beer. However, rice is an important ingredient in many consumers' favorite beers. As more breweries and craft brewers look for economical ways of experimenting with flavor, more are turning to grains such as rice.

Feeding the Family Pet

Many commercial dog foods contain brown rice for its nutritious values. In many cases, dog food is produced using rice "brokens," fractions of rice that don't stay intact during the milling process. Brokens have the same high nutritional value as whole kernels of rice but may not be as attractive on the dinner plate. Therefore, pet food companies make use of this otherwise healthy byproduct. While grain-free pet food may be on the rise, every dog is different and may have different digestive needs. Rice provides a good source of fiber, carbohydrates, and balanced nutrition for humans and dogs alike.

Feeding Livestock

Cattlemen and pork producers encountering higher corn prices may look for feed with an alternative grain – rice. Rice mill feed is typically a blend of rice bran and rice hulls. Rice bran can be fed as full fat rice bran or defatted rice bran. Livestock feed can also contain rice brokens, similar to pet foods.

Eco-friendly Uses of Rice Hulls

Rice hulls can be used for a variety of materials such as fuel, fertilizer, animal bedding, and even building materials. Unground rice hulls are often used for

The rice industry practices sustainable food management, working at each step of the process to reduce waste.

> We don't throw anything away here. Everything has a value to someone or to us.
>
> — Mike Martin, Martin Rice Company

poultry litter and livestock bedding, making useful a waste product from rice production. When the hull is part of parboiling rice, the unground rice hulls can be used in fruit pressing or as a weed control agent.

Bioenergy plants and mills burn rice hulls to produce renewable energy, some producing enough energy to offset the energy needed to run the mill. This is just another way rice mills are working towards a no waste system.

Finally, rice hulls are a viable solution as homebuilders seek more sustainable materials with environmentally friendly attributes such as high availability, low bulk density, strength, abrasiveness, and resistance to weathering. A study conducted on rice hull insulating firebricks found that the bricks could withstand temperatures of up to 1,200 degrees Celsius, or over 2,000 degrees Fahrenheit.[51] Rice hulls can also replace wood for particle board.

SUSTAINABILITY IN ACTION:

Mike and David Martin farm more than 7,000 acres of rice in Southeast Missouri. Three generations of Martins have farmed this land, but that's not all. The Martins produce, mill, and market rice for their family-owned business. Martin Rice Company is a full-service operation that brings rice from farm to table throughout the U.S. and across the globe. The company processes long grain, medium grain, and U.S. Jasmine rice.

"We don't throw anything away here," says Mike about their no-waste facility. Mike trades rice hulls for manure with local chicken farmers. Broken rice is sold for dog food. Local hog farmers purchase rice bran and other waste for hog feed. Everything gets used. "Everything has a value to someone or to us."

Additionally, the Martins are doing their part to help feed the hungry, addressing a need at the top of the Food Recovery Hierarchy, by donating rice regularly to local food banks and to the ecumenical Missouri Festival of Sharing efforts. They also sell rice at cost to charitable and non-profit organizations to supply meal-packaging events throughout the country, leading to distribution of ready-to-cook meals both in the U.S. and worldwide.

Giving Back

With 20 billion pounds of rice grown and harvested by America's rice farmers, the rice industry has the privilege of giving to address food insecurity, working with local food banks, and supporting foreign aid programs around the world. As pillars of the community, mills and farmers have a long history of giving back to their local communities with more than rice. Farmers and millers are community leaders and provide support to local schools, charity events, churches, youth sports, and other community events.

Fighting Hunger in the United States

The rice industry plays a major role in the fight against hunger in the United States with a total of 40 million pounds of rice, including five million donated pounds, distributed through the extensive Feeding America food bank network in 2017.[52] An estimated one in eight Americans struggle with food insecurity.[53] As defined by USDA, food insecurity is a lack of consistent access to enough food for an active, healthy life. This means that 40 million Americans, including 12 million children,[54] do not have access to the healthy foods they need to sustain a healthy life.

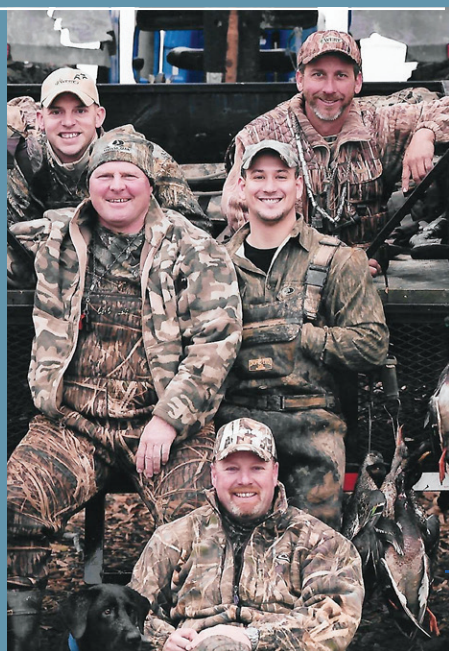
Rice farmers and mills often partner with local food banks, sharing the vision of healthier and happier communities. In every rice producing state, millions of servings of rice make their way to the plates of neighbors in need. Following are just a few examples of giving across the country.

Arkansas: The Arkansas Rice Council collaborates annually with the Arkansas Foodbank to distribute food through five partner Feeding America food banks throughout the state. Six Arkansas rice mills – Cormier Rice Mill, Producers Rice Mill, Riceland Foods, Inc., Riviana Foods, Specialty Rice, Inc., and Windmill Rice – donated a record-breaking 152,600 pounds of rice to the Arkansas Food Bank in 2017. This donation provided over a million servings of rice to families, children and seniors. Additionally, Riceland, Inc. distributes over one million servings a year through its Riceland Cares program throughout Northern Arkansas and Southeast Missouri.

Louisiana: The Louisiana Rice Growers Association teams up with partners such as the Greater Baton Rouge Food Bank and the Second Harvest Food Bank of South Louisiana to celebrate September National Rice Month by serving families across the region where one in five households are at risk of hunger. In 2018, Falcon Rice Mill, Farmers Rice Mill, Planters Rice Mill and Supreme Rice gave nearly 50,000 pounds of rice. Kennedy Rice Mill in Mer Rouge gave an additional 48,000 pounds of rice to the Food Bank of Northeast Louisiana.[55]

Missouri: Missouri rice farmers contributed about 36,000 pounds of rice annually to the Festival of Sharing, an ecumenical effort distributing rice and bean meals in the state as well as donating rice for international aid.

Some rice farmers have found ways to extend their contributions beyond their local community through opening their farms and fields to partner with various veterans' groups in support of those who have served our country as they adjust to life back home. For the past several years, Greg James of Arkansas, along with his father- and brother-in-law, Marvin and Trey Hare, have hosted Appreciation Hunts, working with a group called Faces of Freedom. Greg and his in-laws cover lodging and other expenses to bring a group of former service members, including many Purple Heart recipients, to rice country to enjoy camaraderie and time in the outdoors on a duck hunting trip. Recipients of the hunts have found the experience to be therapeutic and healing, and farmers who host them are grateful for the opportunity to honor those who have served.



SUSTAINABILITY IN ACTION:

In one small Texas community, one man makes a world of difference. Garrett Farms is a fourth-generation family farm in Danbury, Texas. In 1984, John Travis "Jacko" Garrett, Jr., began donating one truckload of rice per year to the Houston Food Bank. After successfully encouraging industry vendors and challenging other rice farmers to donate to the food bank, Jacko founded the Share the Harvest Foundation. Share the Harvest helps feed families in poverty across 18 counties in Southeast Texas—where approximately 900,000 individuals are in need of food assistance—through donations to the Houston Food Bank. When supply allows, Share the Harvest extends its reach to South Texas and San Antonio food banks. Through the contributions of the Share the Harvest Foundation, the Houston Food Bank and its 570 partner charities distribute enough rice to provide more than 11 million servings each year.[56] Many rice industry leaders donate their time, transportation, labor, land, equipment, and milling services for Share the Harvest to supply over 750,000 pounds of rice annually to the Houston Food Bank.

The Houston Food Bank and its 570 partner charities distribute enough rice to provide more than 11 million servings each year.

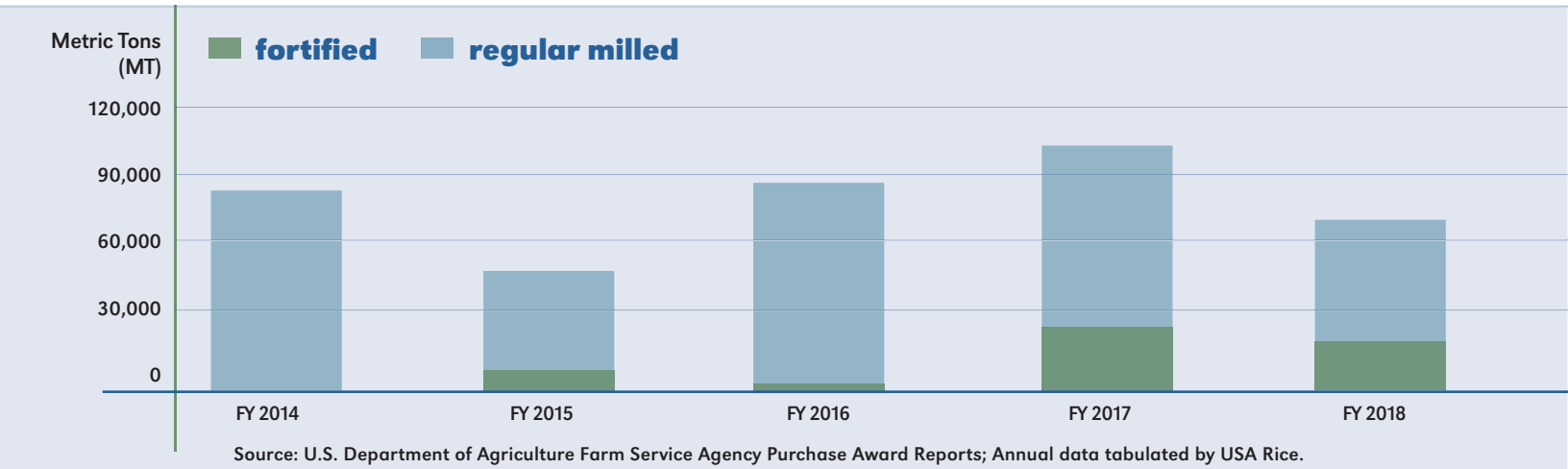
Rice Aids the World

Rice is one of the most widely consumed commodities in the world and is the most consumed commodity for half of the world's population. The U.S. provides milled or parboiled long and medium grain rice for our U.S. government food assistance programs. Anywhere from three to five percent of U.S. rice exports are in the form of food aid, providing a safe and nutritious food for vulnerable or at-risk populations. The rice industry primarily works with the U.S. Department of Agriculture (USDA) and U.S. Agency for International Development (USAID) Office of Food for Peace to deliver rice to the far-reaching corners of the world.

In 2017, the total rice used in food aid programs increased to more than 100,000 metric tons (MT), in part due to the introduction of fortified rice into food aid programs. Implementing agencies are adding fortified rice to their food rations with greater frequency as a superior micronutrient fortified food that can save and improve lives around the world. In one year alone, the use of fortified rice in global feeding programs increased to 25,000 MT from a few hundred tons the previous year.[57]

The chart below shows total U.S. rice shipments in all food assistance programs. Despite total rice shipments being down in FY18, the percentage of rice food aid that was fortified continued to increase.

The U.S. rice industry is optimistic about the continued growth of fortified rice usage in global food assistance programs. In 2018, coated kernel technology was approved and with this second technology available, production volumes will increase, and cost of production will decrease. The U.S. rice industry will continue to work with its partners in industry, government, and NGOs to maximize the usage of conventional and fortified rice to combat the global hunger crisis.



Source: U.S. Department of Agriculture Farm Service Agency Purchase Award Reports; Annual data tabulated by USA Rice.

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End Notes

[1] Field to Market: The Alliance for Sustainable Agriculture, 2016. Environmental and Socioeconomic Indicators for Measuring Outcomes of On Farm Agricultural Production in the United States (Third Edition, P. 26). ISBN: 978-0-692-81902-9. Retrieved 19 October 2018 from https://fieldtomarket.org/national-indicators-report-2016/report-downloads/

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