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What is the Future of Rice Irrigation?

Pending Water Shortages, Increased Water Demands, Poor Economics and Policies, May Threaten the Texas Rice Industry, and Perhaps, the Environment

By Ric Jensen, TWRI Information Specialist

Stretched along the Texas Gulf Coast are hundreds of thousands of acres where rice has been grown for more than 100 years. Rice was introduced to Texas in the late 1800s. At its peak, more than 600,000 acres were planted. That figure has been declining since the early 1980s, and current rice acreage is estimated to be only 210,000 acres.

Historically, most of the rice farming is Texas has taken place in two coastal regions (the West and East "rice belts") that straddle Houston. Along the West rice belt, farmers utilize surface water from many rivers (including the Brazos, Colorado, Guadalupe, Lavaca–Navidad, San Bernard, and Tres Palacios), as well as groundwater, for irrigation. Farmers in the East belt rely on surface water from the Brazos, Neches, and Sabine rivers to meet 90% of crop water needs. On the whole, rice farming relies on rivers to meet 60% of water needs, while groundwater picks accounts for 40%.

Over the past decade, experts suggest that a number of trends are occurring that may put the Texas rice industry in peril. These include low market prices, high production costs, government policies, increased urban demands for water use, and calls for better water quality.

Universities throughout Texas have been studying many issues that relate to rice agriculture, including ways to help maintain the viability of this industry. For example, the Texas A&M University System (TAMUS) Agriculture Program has developed new rice varieties and more water-efficient irrigation strategies, and has evaluated economic and market forces. The Agriculture Program convened a summit to discuss many of these issues in 1997. The Texas Agricultural Experiment Station in Beaumont (TAES), Rice University, and Texas A&M University–Corpus Christi (A&M–Corpus Christi) have led efforts to examine the potential effects of rice production on the environment. Scholars at the LBJ School of Public Affairs at the University of Texas at Austin have assessed policy and regulatory issues that may affect current and future rice production in the Lower Colorado basin.

Recently, the Texas Water Resources Institute (TWRI) has played a role in studying issues related to rice farming. TWRI funded a project at TAMU to develop a geographic information system (GIS) for rice-growing coastal regions. The GIS is available to the public and has been used by many graduate students.

Photo Courtesy of Jim Stansel/ TAES Beaumont

Rice farming (shown here) is widely practiced along the Texas coast.

TWRI also worked the Institute for Science, Technology and Public Policy (ISTPP) to assemble a multidisciplinary team of researchers to study this issue. ISTPP is part of the George Bush School of Government and Public Service and is a unit of the Texas A&M University System. This research team investigated the extent to which rice production may contribute to the ecology of the Texas Gulf Coast, and what the adverse effect of a potential decline in rice irrigation may do to wetlands areas, habitats, and water quality. It also explored economic and policy issues that may need to be resolved if rice agriculture is to rebound. A technical report about this project was jointly published by TWRI and ISTPP in 2000.

Like any issue, determining the future of rice agriculture depends on asking and answering many key questions. For example, is rice agriculture worth preserving and, if so, why? What are the benefits that accrue when rice is farmed? Will there be enough water for rice agriculture, in light of growing demands from cities and industry? What could some of the negative consequences be if rice agriculture were to go away? What can be done to make rice irrigation more viable? We'll answer these questions in this issue.

Rice acreage in Texas has declined from a high of more than 600,000 acres in the 1950s to roughly 210,000 acres today. Today, rice lands account for 5% of the irrigated acreage in Texas, mainly in the Lower Colorado River basin.

Background Information

Rice production in Texas dates back to the late 1800s. The number of acres dedicated to rice has grown and shrunk over the years, reaching a peak of 637,000 acres in 1954. Since that time, acreage has gradually declined to only 318,000 acres today (roughly the same amount that was grown in the 1930s). Texas ranks fourth in the nation in the acres

Photo Courtesy of Jim Stansel/ TAES Beaumont

Water is often distributed to rice fields through canals and gates like this one.

of rice harvested, and rice acreage constitutes roughly 5% of all the irrigated croplands in Texas.

In Texas, rice farming creates an economic impact of roughly $1 billion annually (the fifth-most of any crop). The direct value of rice production is roughly $166 million. Rice production supports more than 6,200 jobs with a payroll estimated at $850 million.

Where is the most rice grown in Texas? The Colorado River basin accounts for 42% of the rice acreage in the state, followed by the Brazos (13%), the Neches (12%) and the Lavaca (9%).

How much water does it take to grow rice in Texas? The answer is unclear, as many agencies and organizations have developed slightly different estimates. However, studies by the Texas Water Development Board (TWDB) suggest that rice irrigation now utilizes roughly 2 million acre-feet (AF) annually, with that figure projected to increase to 2.5 million AF by 2010.

In many ways, rice farming is practiced differently in the East and West rice belts. In the West, nearly 90% of the surface waters used for irrigation are taken from the Colorado River, while aquifers provide needed groundwater. In contrast, nearly all the water needs in the East rice belt are from surface waters, especially the Brazos, Neches, and Sabine rivers. Overall production costs are a little higher in the West belt.

Many experts say that growing rice profitably is especially difficult in Texas, due to high rains and frequent storms, widespread disease, plant pests such as red rice, and damage by animals and insects. Other challenges include the lack of economically viable alternative crops that could be grown alone or in rotation with rice, and relatively high costs for water pumping and distribution. Consequently, growing rice can be a risky proposition, especially since most farmers rely on being able to a grow a ratoon crop each year to remain profitable.

One thing many rice farmers do to increase profits is to grow a second crop, commonly called a "ratoon." Farmers grow a ratoon crop when they add nutrients and water to regrow a rice field that has already been harvested that season. In essence, they are able to grow two crops a year without having to replant a field. Being able to grow a ratoon crop often makes the difference between a year with a profit and a loss.

In addition to producing food, some experts suggest that rice production also enhances the environment by leaving more water on the ground, thus creating a type of wetland. Research by TAES suggests that rice fields support more than 19 species of wintering waterfowl, with an annual population of more than 2 million birds. On the other hand, many studies estimate that worldwide rice production may contribute as much as 17% of the man-made emissions of methane, thus possibly contributing to global warming.

Throughout the United States, per capita rice consumption has more than doubled (to 26 pounds per year) since 1970. Although the United States grows less than 2% of the world's rice, it accounts for roughly 20% of the world trade in rice.

UT Research — Rice Irrigation in the Lower Colorado River

Two recent studies by the Lyndon B. Johnson School of Public Affairs (LBJ School) at the University of Texas at Austin have investigated economic, policy, and water-related issues associated with rice farming.

In 1996, researchers Martin Schultze and David Eaton of the LBJ School and Peter Wilcoxen of the UT Economics Department worked with the Lower Colorado River Authority (LCRA) to study water issues associated with rice farming in the Lower Colorado basin. The project, "Estimation of Derived Demand for Surface Water on Two Rice Irrigation Districts in the Lower Colorado River Basin," involved determining the value of water for rice irrigation, developing a database of rice irrigation districts, and creating a linear model to estimate rice irrigation demands. "This study showed that there are real benefits to implementing water conservation practices in this basin," Eaton says. "Many rice farming operations could become more water-efficient by adopting new technologies."

Recently, Eaton and a team of faculty and students from the LBJ School completed a project to assess the future water supply demands for rice irrigation in coastal counties served by the Lower Colorado River Authority (LCRA). The goal was to evaluate the potential for rice production, and related water demands, over the next 50 years in Wharton, Colorado, and Matagorda counties. The project involved developing data to predict future water demands for rice farming in this region, and comparing these estimates to projections developed by LCRA and TWDB.

Results suggest 12 factors play a large role in determining the future of rice irrigation in the region: production

A project by at the University of Texas LBJ School of Public Affairs recently evaluated likely scenarios for the future of rice irrigation in the Lower Colorado river basin. 12 factors were identified that most influence the viability of rice farming: production costs; water costs; water availability; the federal Farm Bill and other legislation; federal trade policies; Texas laws and regulations; improved technology and irrigation; the rice farming infrastructure; whether rice is farmed by landowners or tenants; the availability of loans; and whether farmers are willing to change.

Photo Courtesy of Jim Stansel/ TAES Beaumont

Precision or laser leveling (shown here) is one method decrease water use in rice farming.

costs; water costs; the availability of water; federal legislation, specifically the Farm Bill; the stability of international market prices; federal agricultural trade policies; Texas laws and regulations; improved technology and irrigation methods; the infrastructure that supports the rice industry; land leasing agreements; the ability of rice producers to be able to borrow money to meet production costs; and the behavior of agricultural producers.

"The single most important factor that will predict how well the rice industry fares in the future," Eaton says, "is how much money it will take to grow a viable crop. Our study suggests that even though other factors are very important, including the price and availability of water and technological breakthroughs. The true bottom line is likely to be whether the economics will allow rice producers to remain profitable and stay in business."

In this project, the research team incorporated the likely effect of each of these 12 factors to develop "what-if" scenarios about the future of rice farming in Texas: a case in which rice production would not survive, thus virtually eliminating irrigation demands in the region; a situation in which there would be large growth in both rice acreage and water demands; and a middle-ground where rice production would remain relatively stable.

According to Eaton, the research suggests that rice farming in Texas will likely experience moderate to expansive growth, if producers are able to continue producing a ratoon crop in most years. Being able to produce a ratoon crop provides extra revenues that help ensure farmers remain profitable. Still, it is dependant upon having enough water available for irrigation.

Eaton warns that the lack of enough water to grow a second crop could cause serious harm to the industry. "Future decisions made by LCRA to change the distribution of water between agricultural and municipal customers or to raise water rates for rice farmers will probably have a direct effect on this industry," Eaton says.

TAMU Study Examines How Rice Farming Affects the Environment

In 1999, TWRI and the TAMU Agriculture Program worked with ISTPP to develop a comprehensive, multi-disciplinary study to determine how a potential decline in rice production may negatively affect the environment. Project coordinators were Wayne Jordan, the former Director of TWRI, and Arnold Vedlitz, who leads ISTPP and is also a researcher in the TAMU Political Science Department. Lead investigators in the project included Letticia Alston of ISTPP, Tom Lacher and Doug Slack of the Wildlife and Fisheries Sciences Department, and Richard Woodward of the Agricultural Economics Department. The project involved one post-doctoral research associate and 11 research assistants spread across six academic units.

"We felt this study was needed," Jordan says, "because the ecological benefits that may be associated with rice production are so poorly understood. Obviously, there are justified concerns about wetlands losses along the Texas coast. We wanted to quantify the ecological values that may be associated with rice production, including learning about the extent to which flooding rice fields over prolonged periods of time may mimic the role of wetlands."

The broad goals of this multi-faceted project were to develop (for the first time) a reliable estimate of the environmental consequences of reductions in rice acreage, and to analyze the economic consequences of reduced rice acreage. Another goal was to critically review existing policies and explore future strategies that might be developed to help rice farmers become involved in multiple land uses, including ecological enhancement and recreation.

Another phase of this study consisted of developing and analyzing long-term databases about the potential relationship between rice acreage and migratory birds. According to Slack, the studies show that rice farming produces a variety of habitats used by a wide range of avian species. Declines in some waterfowl were tied to decreases in rice acreage.

This study also examined the economics of rice production in Texas. Woodward led work to investigate how recent changes in federal farm programs may affect the profitability of rice farming. In general, he found that the costs of rice production often exceed the benefits and profits that are generated, though it should be noted

TWRI, the TAMU Agriculture Program, and the TAMUS Institute for Science, Technology and Public Policy recently cooperated in a major multi-disciplinary study of the ecological value of rice ecosystems. The goal was to evaluate the extent that declines in rice acreage may result in a loss of wetlands functions. The study also investigated economic and policy issues that are adversely affecting the rice farming industry. The project identified opportunities for rice farmers to work with government programs, non-profit organizations, and the private sector to obtain additional resources. The project is unique in that in combined the talents of agricultural researchers with scientists involved in policy making. A technical report on this project is available free from TWRI while supplies last.

that many farmers do make a profit. Woodward and Slack examined the extent to which rice producers could earn additional money by encouraging hunting and bird watching activities on their lands. Results suggest that while leasing farmlands for hunting may be profitable, there are doubts about the amount of revenues that can be created through birding. The researchers also suggest that additional research needs to carried out to investigate the non-market benefits of rice production. In other words, what values may society place, and be willing to pay, for some of the water quality and habitat benefits provided in part by rice farming?

Reviewing existing federal and state policies and assessing their impact on rice agriculture was another major study objective. To gather this information, Alston and Vedlitz led efforts to survey small groups of rice producers, representatives of environmental groups, and the public. The researchers identified the 1996 Farm Bill as one of the most important policy issues that affect the rice industry, in that it virtually eliminates subsidies to support farming and shifts risks from the government to agricultural producers. Survey results from this project, and others, suggest that many farmers say they anticipate farming less rice acreage or getting out of agriculture altogether, due in large part to the Farm Bill. The researchers also explored whether the land tenure system may affect whether rice producers are willing to participate in government subsidy programs to protect water quality and the environment. The research shows it may be difficult for tenant farmers to take part in these programs, since these efforts are mainly intended to benefit landowners. The surveys revealed that several environmental groups said they would be willing to support producers of rice and other crops who utilized environment-friendly practices.

Research by TWRI and the ISTPP revealed a number of significant trends which are now affecting rice production in Texas. First, without government subsidies, the revenue generated by rice production has typically not been sufficient to cover the costs of land ownership and production. Second, the continued viability of rice farming in Texas may be threatened by the 1996 federal Farm Bill. Third, the infrastructure that supports rice production (drying, milling, and transportation) is declining. Fourth, it is anticipated that in the near future, rice farming will be adversely affected by urban expansion in two ways. It will convert agricultural acreage into lands for homes and businesses, and will heighten competition for water resources by increasing demands to convert irrigation water rights to municipal uses.

If these reductions in rice acreage do occur the research team suggests a loss of ecological services will also occur, since artificial wetlands created by rice farming will decline.

TAES Field Studies

For many years, scientists at the TAMU Agricultural Research and Extension Center at Beaumont have cooperated with colleagues at the United States Department of Agriculture Research Service (USDA/ ARS) to study ways to improve rice production.

According to TAES scientist Jim Stansel, field research in Beaumont has contributed significantly to improve rice production. This involves developing new rice varieties that increase yields, the use of integrated pest management to lessen the need for pesticides, and strategies to lessen water use by flooding fields at shallower depths, precision leveling fields, and reducing the volume of water needed to flush fields.

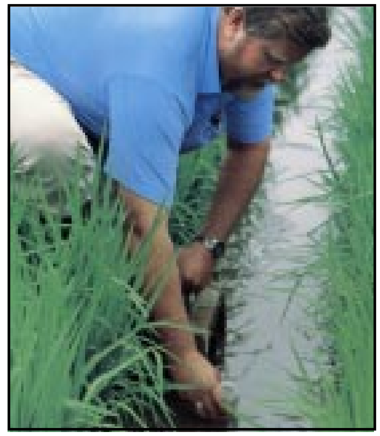

Photo Courtesy of Jim Stansel/ TAES Beaumont

Garry McCauley of TAES takes a water sample from this rice field in Beaumont.

In the mid-1990s, studies by agronomist Garry McCauley involved measuring water quality before it entered and after it left rice fields. Results showed that most of the chemical inputs applied to rice can be kept in the field, and will likely not run off, if best management practices (BMPs) are used. As a result, improved management guidelines have been developed that are being implemented by rice producers throughout Texas. The BMPs recommend that pesticides and nutrients be left on the field for about a week after being applied, thus protecting water quality.

According to Stansel, the future of rice agriculture appears to be bright, especially if new varieties are developed and introduced that produce higher yields and can better tolerate stresses associated with extreme temperatures and drought. If these new cultivars are resistant to insects, herbicides, and diseases, they could help farmers reduce red rice, thus making rice growing more profitable. Stansel is hopeful that improvements in water distribution systems and laser-leveling will minimize water use and expand the opportunities to grow a ratoon crop. He suggests that economic incentives ought to be provided to assist rice farmers in constructing and maintaining wildlife habitats.

"The ecological and economic benefits to Texas can be significant over the next 50 years, if those involved with rice farming are good stewards of land and water resources," Stansel says. "I know rice farmers are committed to do their part to significantly improve the economic and ecological well-being of Texas."

Other University Research

Scientists throughout Texas have investigated several issues related to rice production.

In 1997, TWRI funded work by researcher Robert Coulson of the TAMU Entomology Department to develop a GIS that can be used to assess how changes in water use and reductions in rice irrigation may affect the ecology of the region. That GIS is now available to the public on a CD.

Recently, TAMU graduate student Laura Musacchio utilized this GIS to develop an ecological planning process for wetlands and lands now used for rice farming. Musacchio assessed how developing and implementing land use plans with multiple objectives for rice production may affect wetlands and wildlife along the Texas coast. She evaluated whether differences in rice production methods may affect the number of migratory birds that overwinter in rice fields, as well as the ecology and economics of the region. The findings may be useful in developing policies that enhance profitability for rice farmers and benefit the environment.

Another new study by TAMU researchers examined the environmental fate of a commonly-used pesticide in Texas rice production. The project, which was led by graduate student Gene Lindemann and researchers Don Reddell and Ann Kenimer, consisted of a two-year field study at sites in Colorado and Wharton counties. The goal was to assess molinate concentrations in surface water runoff. According to Lindemann, molinate decreased to levels so low it could not be detected 35 days after being applied. The research suggests that farmers can significantly reduce the risk of pesticide runoff by flooding water at shallower depths and leveling fields with lasers.

Photo Courtesy of Elizabeth Smith/ TAMUCC

TAMUCC researchers studied how rice irrigation may affect coastal ecosystems.

Throughout the 1990s, researchers Frank Fisher and Ronald Sass, and graduate student Yao Huang of Rice University have been conducting field studies in rice fields near Beaumont. Their research has focused on identifying the extent to which different environmental factors (soils, the variety of rice grown, and crop yields) contribute to methane emissions. Another component of the research involves determining how the various growth stages of rice plants may influence methane production. The studies show that it is possible to develop equations that correlate environmental factors to methane emissions, and suggest the morphology of a rice crop plays a key role in methane production. Sass says the research also has practical value to rice farmers. Results suggest that periodically draining a rice field for a few days may stop the production and emission of methane for up to three weeks, while not reducing yields.

At Texas A&M University–Corpus Christi, researchers Elizabeth Smith and Suzanne Dilworth recently carried out a project to assess whether water that drains from rice irrigation fields may be affecting the populations of benthic organisms that live downstream. This study was conducted on three rice farms near West Matagorda Bay. In the project, the researchers collected monthly water quality and benthic invertebrates samples during 1998. Their research suggests that freshwater releases from rice farming could benefit or harm benthic organisms, depending on whether the time they were released coincided with instances when invertebrates are colonizing wetlands areas.

Summary

On the surface, it appears that there are many reasons to be concerned about the future of rice irrigation in Texas. Obviously, the economics need to be improved, especially in light of changes brought about by the 1996 Farm Bill. The point is that rice farming has to be a profitable industry for those who participate in it, or else it will likely be diminished or disappear altogether.

Other than merely economics, there are other compelling worries that threaten rice irrigation. As Houston and its suburbs expand, two things will likely occur simultaneously. First, lands used for rice and other crops will be converted to homes and businesses. Secondly, waters now used to grow rice and other crops will be demanded by urban interests.

Many of us take for granted the notion that, as Texas' population grows and the state becomes more urbanized, it is only natural that agricultural lands will have to decline. Policy makers and the public need to seriously contemplate what the external affects of a decline in rice production may mean for coastal ecosystems.

As demonstrated by recent studies by TWRI, the TAMU Agriculture Program, and the ISTPP, the potential environmental benefits that accrue because of rice farming need to be examined. Conversely, the potential detriment to the environment of removing large amounts of rice acreage need to be considered.

The bottom line is that many experts believe that rice farming, by leaving water in place for long periods of time, may actually mimic many of the functions of natural wetlands. As a result, rice farming may actually help facilitate the environmental objectives of many agencies and groups by enhancing habitat for migratory birds, by providing flows of surface water to bays and estuaries, and by filtering pollutants and improving water quality.

If maintaining rice production is to be desired, the question then becomes how can the economics be turned around so that rice farmers can stay in business. In one corner, many professionals working with this industry think that advances in technology and policies will help rice agriculture rebound. First, many researchers anticipate that new rice varieties may be developed that will increase yields and lower costs. Second, there is optimism that new markets for rice exports will be developed, thus helping make rice farming more viable. Thirdly, other researchers suggest that developing recreational uses, especially hunting and perhaps bird watching, may provide enough extra revenue to help rice farmers survive.

Perhaps the best way to help preserve rice farming may be to develop programs, both throughout governmental agencies and in the private sector, that realize that keeping lands in rice production may help enhance the environment. For example, the federal government has already created and implemented "green payment" programs that reward farmers when they protect natural resources. If applied to rice production, these efforts may likely help keep farmers in business and benefit the environment.

For More Information

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News from TWRI

TWRI recently experienced a change of Directors. Wayne Jordan, who served as Director for many years, is now leading the TAMU program in Molecular and Environmental Plant Sciences. The New TWRI Director is C. Allan Jones, who is an Assistant Vice Chancellor in the TAMUS Agriculture Program and who served as the Resident Director of the Blackland Research Center. Jones can be contacted at cajones@tamu.edu. TWRI's new administrative assistant is Rosemary Payton. You can reach her at (979) 845-1851 or r-payton@tamu.edu.

TWRI recently selected 11 projects it intends to fund in 2001–2002. The emphasis of the program now more broadly involves graduate students in research. By awarding smaller amounts ($5,000 per project) more studies can be awarded. This year, TWRI will fund research projects at Texas A&M University, the University of Texas at Austin, Texas A&M University–Corpus Christi, Texas Tech University, Texas A&M University–Galveston, the University of North Texas, and the University of Texas Marine Science Institute at Port Aransas. The projects cover many topics, including computer modeling, wetlands, water quality, the affect of toxic pollutants on ecosystems, water management, and many other issues.

A new technical report, *Brush Management/ Water Yield Feasibility Studies for Eight Watersheds in Texas*, has been jointly published by TWRI and the Blackland Research Center (BRC) in Temple. The report summarizes work to assess how brush control may improve water yields. Single copies are free from TWRI while supplies last.

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As Editor of Texas Water Resources, I want to know what readers think about the newsletter. Please take a few moments and fill out this survey form. Fax your answers, along with your name and address, to TWRI at (979) 845-8554.

We will conduct a random drawing of those respond. The winner will receive a free copy of *Isaac's Storm*, a book about the Galveston flood of 1900. The winner of the last drawing was Robert Gafford of Alice, TX.

Ric Jensen, Editor, *Texas Water Resources*

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4. If *Texas Water Resources* were published only on the World Wide Web (not printed) would you still read it? (Y/N)
5. Which topics should be discussed in future issues of this newsletter?

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