Water Currents

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Dear Reader,

Texas rice farmers are major consumers of our state's water resources. The combination of falling water tables and rising fuel costs have made irrigation expense a large and ever increasing percentage of the rice farmer's operating costs. Uncertainties about future water availability have added to the problem. Water use must be reduced to meet the challenges of increased cost and reduced availability.

Two years ago, a number of concerned rice producers approached TAES researchers to develop a rice research program focused on solving the serious cost-price squeeze that existed. In response, TAES developed the "ECONORICE" program, an accelerated rice research effort with emphasis evenly divided between varietal improvement and more efficient cultural practices.

The Texas Rice Research Foundation was formed to raise necessary funding for this project and to oversee the implementation. The 12 producer-trustees proposed a voluntary five cents contribution for every hundredweight of rice marketed. In the first year of operation, 1982, over $650,000 was raised. The expanded and accelerated research program is underway, with significant results already attained.

More efficient and effective use of water is a vital part of the ECONORICE program. The Texas Rice Research Foundation is delighted to see **Water Currents** feature this research effort in this issue.

Barry Jeffrey

Chairman

Texas Rice Research Foundation

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Crisis in the Rice Belt

Texas rice farmers often reminisce about the good old days. They remember the days - not so very long ago - when water for irrigation seemed inexhaustible and when their energy costs seemed reasonable. They remember when new varieties of rice increased yields almost annually and when the results of agricultural chemicals were worth far more than their application costs.

The same farmers would like to forget a few more recent years. Those were the years when their costs for energy and water soared while their yields failed to increase; when competition for limited water became fierce; and when the expense of applying fertilizers, herbicides, pesticides, and fungicides often exceeded the value of the crop.

Today Texas rice farmers face an immediate crisis. They must reduce production costs to stay in business. Texas rice farmers now spend more to produce rice than farmers in any other rice growing area in the world. They know that energy is their number one production cost and that two-thirds of their energy cost is used to irrigate their crops. They also know that their production costs have doubled in less than ten years primarily because of high water and energy costs.

As Texas farmers remember their good yields in years past, they frequently recall the help they have received from the Texas Agricultural Experiment Station (TAES) research center near Beaumont. Scientists stationed at the center have for the past 74 years consistently found solutions for rice production problems. TAES and U.S. Department of Agriculture (USDA) scientists through the years have developed new rice varieties; have improved methods of planting, harvesting, and marketing; and have developed effective ways to control weeds, diseases, and insects.

As a result of new technology through research, one-fifth of all the rice grown in the U.S. comes from the 18 counties which make up the Texas Rice Belt. Texas rice producing counties follow the coast from the Sabine River to the Guadalupe River and include Austin, Brazoria, Calhoun, Chambers, Colorado, Fort Bend, Galveston, Hardin, Harris, Jackson, Jefferson, Lavaca, Liberty, Matagorda, Orange, Victoria, Waller, and Wharton. Bowie County in Northeast Texas also produces rice, but its climate and cultivation methods are more closely related to rice producing areas in Arkansas than those of the Texas Gulf Coast.

Even though rice grows in only a small portion of the state, it ranks as one of Texas' top five cash c crops. Only cotton, grain sorghum, corn, and wheat bring more dollars than rice to agricultural crop producers.

Texas rice farmers, however, have balanced precariously at a break-even point in recent years. They hope that current TAES and USDA research (1) can again increase the yield per acre, (2) can decrease the amount of water needed for rice production and (3) can reduce other costs, especially the energy costs, of rice production. Rice producers know that they must find ways to reduce production costs if they are to remain competitive in the world rice market.

A major emphasis of the current TAES rice research program addresses how farmers can reduce the amount of water needed to grow rice in Texas. This issue of **Water Currents** presents TAES research projects on rice water management now underway in laboratories, greenhouses, and research plots at the Beaumont and Eagle Lake research centers, on the main campus at Texas A&M University, and in private fields across the Rice Belt.

TAES researchers have studied rice production methods almost as long as Texas farmers have grown the crop. They have studied rice cultivation since the Texas legislature established the center near Beaumont in 1909 and charged TAES to improve rice production methods. Three years later, USDA joined the state efforts in rice research and has conducted joint rice research with TAES ever since.

TAES rice research has concentrated primarily on efforts to increase rice yields. And yields per acre have indeed increased in the state. Texas rice production reached a high per acre yield of 5,000 pounds per acre in 1967 after several years of significant yield increases from varieties developed by TAES and USDA plant breeders. But rice yields in Texas reached a plateau in the 1970s, and both acreage and yields per acre have decreased in recent years. Farm economics and increasing competition for area resources have caused decreases in rice production.

Water is probably the major limiting factor in rice production today even though by Texas standards the Rice Belt receives an exorbitant amount of fresh water. Not only does (he area have an average annual rainfall ranging from 55 inches at Beaumont to 34 inches at Victoria, but it also has 9 of the state's 14 major rivers flowing through it. The area's gentle slope towards the Gulf, and its proximity to saltwater, though, preclude constructing reservoirs to store fresh surface water until needed for irrigation.

The Rice Belt also has fresh water available from the giant Gulf Coast Aquifer with its high rate of annual recharge. In recent years, however, overpumping of the aquifer for urban, industrial, and agricultural uses has caused the layers of the aquifer to compact so that the earth's surface subsided in parts of the Upper Gulf Coast Region. Overpumping also caused the aquifer's water levels to decline, thereby increasing pumping costs.

Because water is a major cost of growing rice and an increasingly limiting factor in Texas rice production, TAES researchers have concentrated in recent years on water management in rice production.

James Stansel, resident director of the Beaumont research center, promises several technological breakthroughs on the immediate horizon which should allow producers to grow more rice with less water and help maintain rice as a viable Texas crop.

USDA and TAES plant breeders under the direction of Charles Bollich released a new rice variety in 1983 which has the potential, according to Stansel, to increase state average yields 20 percent by 1985 **without increasing water or energy requirements.** He predicts this yield increase based on the performance of a semi-dwarf variety named Lemont. TAES and USDA researchers have studied Lemont in test plots for several years as well as on 2,000 private acres planted across the Rice Belt this year.

Another research effort which will soon be ready for producers, says Stansel, is a special seed coating of calcium peroxide developed by TAES plant scientists under the direction of Fred Turner at the Beaumont center. The special coating supplies needed oxygen which allows rice seeds to germinate under water. Farmers can save fertilizer and other production costs, Turner explains, by eliminating the field draining and re-flooding step currently needed for seeds to germinate in moist but not flooded fields. With constant flooding during seed germination and early plant development, farmers could also eliminate red rice - their most costly weed.

Other research work at the Beaumont station soon to be saving water in rice fields includes:

- more semi-dwarf varieties of rice which require less water and less growing time.
- Ionger-lasting herbicides which will increase weed control effectiveness, reduce application costs and reduce water use.
- irrigation scheduling methods to save both water and energy.
- new fungicides which increase the present span of disease protection.

A Drastic Change

Virtually all rice grown in Texas for the past 90 years has matured standing in flooded fields. But there might be a better way to grow rice in Texas, say researchers with The Texas Agricultural Experiment Station.

Rice does not require flooded conditions, they say; it merely adapts to inundated fields. Rice, in fact, needs no more moisture to produce than other Texas crops such as wheat or grain sorghum.

TAES researchers propose applying irrigation water with a sprinkler system similar to the ones used by irrigators in other parts of Texas.

Their current research on sprinkler irrigated rice could save a great deal of water. Preliminary results, the scientists say, show that sprinkler irrigation could reduce water use of rice production from the present 3.5 to 7.5 acre-feet per acre down to less than one

acre-foot per acre. Multiplied by the 500,000 acres of rice generally grown in Texas each year, the potential water savings are tremendous.

Converting to sprinkler irrigation could save more than water in rice production. TAES researchers suggest that fertilizer, herbicides, insecticides, and fungicides could be applied through the sprinkler irrigation systems. This method would require a fraction of the energy needed by present methods using land machinery or aerial application.

Irrigating rice by sprinkler systems instead of flood methods represents such a drastic change from present rice culture methods that TAES researchers have approached it as an essentially new agronomic crop. They initiated a large-scale research effort in 1980 to evaluate the potential of sprinkler irrigation for rice and to evaluate cultural management changes necessary with the new type of rice production.

Garry McCauley, TAES soil physicist at the Beaumont research center, heads the project to assess the potential of sprinkle irrigated rice. McCauley's preliminary results show that sprinkler irrigation can be a water-saving and energy-saving alternative to flood irrigation in rice production. The TAES research efforts presently underway are fine examples of cooperative research by scientists from different disciplines.

Plant breeders seek varieties best suited for sprinkler application. They are especially interested in rice varieties showing tolerance to moisture stress.

Plant scientists study the rice plant's adaptability to sprinkler irrigation and identify the critical development stages when water stress affects yield.

Plant scientists also assess the nutritional needs of sprinkler irrigated rice.

Soil scientists look for soil characteristics most desirable for sprinkler irrigation. They use rainfall simulators to assess the infiltration rates of different types of soils.

Soil scientists evaluate methods to reduce soil crusting. Crusting, a major concern of scientists studying sprinkler irrigation of rice, is the formation of a hard crust on the soil surface which prevents infiltration of water into the soil moisture. TAES researchers test soil modifications such as soil amendments and cultural techniques such as crop rotations to reduce crusting.

Weed specialists play an especially important role in the sprinkler irrigation study. They study types of herbicides and application methods effective in sprinkler irrigated rice cultivation. Scientists say weed control is a major expense of rice production and expect it to be an even greater expense in sprinkler irrigated cultivation. Flooding now controls many weeds in rice fields which might seriously reduce the quantity and quality of rice under sprinkler irrigation.

Entomologists and pathologists analyze how changing the method of irrigation would affect rice field pests. Eliminating the flooded fields would change the environment drastically and perhaps change the types of insects and diseases affecting rice production.

TAES agricultural economists study the economic feasibility of sprinkler irrigation. Sprinkler systems would mean a sizable capital investment for rice farmers - already caught in an economic squeeze.

Agricultural economists also assess the economic implications of using sprinkler irrigation on alternative crops as well as rice. Soybeans, winter wheat and grain sorghum could benefit from sprinkler systems and could provide the rice farmer with several options for his investment of a sprinkler system.

It is still too early, say TAES researchers, to know whether a rice farmer should change from flood irrigation to sprinkler irrigation. Preliminary results, says McCauley, show that sprinkler irrigation offers a water-saving and energy-saving alternative to flood irrigation.

The potential savings in water and energy make the possibility attractive and well worth the attention of TAES rice researchers.

Ripples & Waves

TAES researchers initiated a comprehensive Water Management Study in 1980 to improve current water use practices in rice fields and to develop innovative ways of conserving water in future rice production. They work in cooperation with area Soil Conservation Service (SCS) field specialists and with USDA researchers stationed at Beaumont.

Garry McCauley, a TAES soil and water physicist, coordinates the study involving plant scientists, soil scientists, agronomists, entomologists, pathologists, soil chemists, agricultural engineers, and agricultural economists.

The scientists conduct field tests on the 950 acres available for research at the Beaumont center. Field research also takes place on land owned or leased by TAES in six locations across the rice belt. These field sites allow scientists to evaluate rice varieties and management practices in the different climates and soils found in the Texas Rice Belt.

TAES and SCS researchers have also monitored water use and loss in private fields in eight counties across the Rice Belt for the past two growing seasons. Measurements taken at each site include: irrigation water delivered to a field; water drained from the field; water consumed by the rice plants; water infiltrating the soil profile; rainfall, temperature, and pan evaporation; and water lost from canals.

McCauley and other scientists will use the monitoring results to develop a total water budget for rice fields in different climatic regions and with different soils. Their results

should help rice growers identify water losses, analyze their crop's water needs, and make management changes to reduce the amount of water required. McCauley says that this research is the first comprehensive effort to understand water demands and water losses in rice fields.

The research should help farmers make some very simple modifications in their water management practices to reduce water use such as flooding and draining schedules and planting water efficient varieties of rice.

Study results, however, may mean recommending major capital investments for farmers in order to reduce the amount of water needed for future rice crops. Some of the improvements now under investigation include

- land leveling in order to retain a uniform depth of flood.
- Iined canals to reduce some of the seepage losses as water is delivered to rice fields.
- pipe installed to replace canals to eliminate both seepage and evaporation losses in delivery systems.
- tailwater systems to channel water drained off a field into another field or into a holding pond to be reused on the same field.
- better methods to hold and use rainfall.

Although the water budgets and other research findings are directed specifically for Texas rice farmers, TAES and SCS researchers hope that the findings will be useful to rice farmers throughout the world.