RICE WATER USE IN THE MISSISSIPPI DELTA

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INTRODUCTION

Rice production in Mississippi began in Bolivar County in the late 1940's. Two considerations stimulated the development of the rice industry. The first was the availability of large acreages of inexpensive soil highly suited to rice. The second factor was the availability of large quantities of high quality water in the relatively shallow alluvial aquifer. This provided a plentiful and cheap supply of water for rice production. The aquifer was thought to be nearly inexhaustible in that recharge would maintain water levels. This was a prevailing attitude among farmers in the Mississippi Delta until the early 1980's.

The expansion of the rice industry from its infant days of about 40,000 acres to over 250,000 acres today has put considerable stress on the alluvial aquifer. In addition, use of ground water is being constantly increased with the development of irrigation for cotton and soybeans. The rapid expansion of the catfish industry has put further stress on the aquifer. The U.S. Geologic Survey began observing water level declines in the aquifer by the 1970's. The problem was brought to the attention of area farmers in the late 1970's and the early 1980's. A concern with conserving the water in the agriculture aquifer led to the development in the late 1980's of the Yazoo-Mississippi Delta Joint Water Management District. This organization was charged with, among other things, the measurement of water use from the aquifer and the development of alternative water sources. One of the principal concerns was the development of benchmark data on average water use for rice, cotton, soybeans, and catfish. This report will deal with various studies which have been conducted to develop such data for rice, the principal agricultural water user, in the Mississippi Delta. An effort to develop agricultural water use numbers was begun by the Mississippi Agricultural & Forestry Experiment Station and the Mississippi Cooperative Extension Service (MAFES and MCES), Delta Research and Extension Center, in 1988. The Mississippi Agricultural Statistics Service attached an irrigation questionnaire to the surveys normally sent to cotton, soybean, and catfish producers. The data was found to be reliable for cotton and soybeans but data from the survey on catfish was not usable. At the same time, a mail questionnaire was developed for rice producers. The sample included 210 farmers from which 183 usable questionnaires were obtained. Analysis of this questionnaire indicated that in 1988 average rice water use was 76 inches per acre of rice. It had not been anticipated that rice water use would be this high and there was considerable concern expressed as to the reliability of this data.

In 1990, a contract between MAFES, Stoneville, and the Yazoo-Mississippi Delta Joint Water Management District was entered into where well water use would actually be measured. This work identified three factors which explained problems with the data taken in 1988. First, irrigation wells in the Mississippi Delta yielded 15 to 30 percent less water than producers indicated. Secondly, hours of annual use as estimated by farmers was shown to be considerably less than what they reported. The third factor was that during the 1988 growing season rainfall was poorly distributed requiring considerably more operation of wells than usual.

1990 RICE WATER USE STUDY

The objective of the study in 1990 was to measure and compare water use on three different types of rice fields -- unformed, formed with the cross slopes still present, and on straight levee rice fields where the fields had been formed to grade one direction with a zero grade. To obtain this data, the Mississippi Cooperative Extension Service held meetings in the three principal rice producing counties -- Bolivar, Sunflower and Washington -- to explain the purpose of this study to rice producers and seek cooperation. This selection of producers to participate in this study precluded any ability to draw a random sample of producers in the area. This study should probably be identified as a case study. However, all producers participating in this study grew one of the four principal rice varieties produced in the area at that time. The soils in all fields ranged from silty clay loams through clays. The information required for this study was to determine: (1) the flow rate of the well, (2) total pumping hours, (3) acres of rice served by the well and (4) yield. The hours the well was operated was

kept by the farmers themselves but required frequent visits to be sure such data was recorded.

Table 1 indicates the simple calculation required to develop the inches of water used to produce rice on each of the fields. The data from unformed fields and contour formed fields indicated no significant difference in water use between these two types of fields. However, the data indicated a significant reduction in water use on straight levee rice fields (Table 2). The data indicated a difference of approximately 14 inches per acre of rice. Equally important, this data indicated a significant difference of 16 bushels per acre in yield between unformed and contour formed levees and straight levee rice fields. Table 3 presents the economic differences in cost and returns between straight levee rice fields and other rice fields. The 14 inches of water savings resulted in a reduction in cost of $10.22 per acre while the yield increase resulted in a $52 increase in the value of production per acre for a benefit of $62.22 per acre for the straight levee rice fields. Table 4 presents the specified returns and assuming a cost of converting contour formed fields to straight levee fields of $150 per acre, we clearly see that straight levees can result in improvement in returns above cost per acre of $35.67. It should be pointed out that the reduction in water use and increased yield represent only two of the benefits associated with straight levee rice fields. Some of the other benefits reported by farmers with straight levee rice fields indicated a significant improvement in performance rates of combines. That is, more acres of rice could be cut per machine per day, thus reducing harvest cost. Another improvement is in the cost of the rice waterer or tender. With straight levee fields, the rice tender can supervise more acres of rice and do a more effective job of maintaining a flood throughout such fields. Producers also felt that land preparation costs were reduced, rice was planted in a more timely fashion, and the flushing of the fields for germination of the seed was more rapid and more efficient resulting in better stands.

RICE WATER USE STUDIES - 1991 and 1992

In 1991 and 1992, studies were specifically designed to give a statistically reliable estimate of average water use in the Mississippi Delta for rice production. Mississippi Agricultural Statistics Service drew samples of rice producers for 1991 and 1992. The intended purpose of this sample was to provide data from rice farmers which could be considered typical or the norm for rice production in the Mississippi Delta. That is, it was assumed that the practices and inputs would be reflective of rice production in the area. It should be pointed out that resources were not sufficient to identify specific soil types associated with each field due to variability of soils in the field. An assumption was made that soils with excessive deep percolation would be included in the study. Fields with soils associated with high deep percolation rates have not been in the sample according to published county soil maps. The rice varieties included in these samples again reflect the three to four most widely grown varieties in the area. Data collection from the wells included in the studies in 1991 and 1992 involved some three to four readings of the wells during the growing season and the readings were taken at the recommended RPM for each well. This helps eliminate some of the risk of missing flow variations during the season. Thirty-two wells was selected using this sample in 1991. Average rice water use in 1991 was found to be 32 inches per acre and ranged from 20 to 42 inches per acre. Electronic time totalizers were installed on all 32 wells in 1991 to record operating hours. Some of these totalizers were induction type totalizers for use on electric motor wells. Most of these totalizers failed. In addition, other wells were lost due to being struck by lightening, fires, and being struck by vehicles. Thus, data was only obtained from 15 of the 32 wells in 1991. However, this data was considered to be statistically valid but just barely. For this reason, a larger sample of fields was obtained in 1992 and data was taken from 43 wells. Fewer totalizers failed in 1992 and data was obtained from 35 wells showing an average use of 27 inches of water for rice production in 1992. The range of water use by wells was from 12 to 39 inches per acre. Resources were not available for more frequent well readings nor were resources available to install permanent flow meters on these wells. For this reason, there may be data inconsistencies due to operating wells at lower RPM during certain time periods.

PLANS FOR 1993 AND SUBSEQUENT YEARS

It must be pointed out that to establish a benchmark number of the average rice water use, wells will have to be monitored from 3 to 5 years depending on climatic conditions during the growing season. The work in 1991 and 1992 were in years of adequate rainfall and perhaps more importantly with good distribution of rainfall. An average water use number could be deceptively low without the inclusion of data from a dry season or a season with uneven rainfall distribution. The study in 1993 will be expanded to approximately 70 wells. Block sampling will be used rather than producer sampling to obtain data on variability of water use between specific rice fields

under the same management. A new, more rugged, and easier to use flow meter is being obtained to start the 1993 study. No induction totalizers will be used. All totalizers will be driven by sensing vibration of the well or engine when the well is in use. Additional experience and skill in this work has allowed us to increase the number of wells and the number of readings of each well throughout the growing season. In 1991, the wells were read an average of three times during the growing season and slightly over three times in 1992. Upon completion of this study, a final report will be published by Mississippi State University.

Table 1

Calculation for Inches of Water Used

$$\frac{(\text{GPM}/452.6) \times \text{Hours of Well Use}}{\text{Acres in Field}}$$

Table 2

Difference Between Contour and Straight Levee Rice Fields

Field Type	Water Use (in/Ac)	Avg Yield (Bu/Ac)
Contour	46	132
Straight	32	148
Difference	14	16

Table 3

Economics of Straight Levees

	Straight	Contour
Cost of water/acre	$ 23.36	$ 33.58
Difference	10.22	
Yields/Acre	481.00	429.00
Difference	52.00	
Total Difference	62.22	

Table 4

Net Returns of Straight Levees

Returns to straight levee	$62.22/Acre
Costs of straight levee	$26.55/Acre
Returns above cost	$35.67/Acre