1988 RICE WATER MANAGEMENT STUDY

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INTRODUCTION

In 1988 the Soil Conservation Service (SCS) Water Management (WM) team monitored several fields of local cooperators. The objective was to apply water conservation practices on two of the fields to determine the value of the practices for water conservation.

FIELD MONITORING

The 1988 rice water management study was conducted on four fields of local cooperators. The fields, with the exception of field 3, are shown in Figure 1.

Field 1 and 2 were adjoining fields and were land leveled for straight levees in the spring of 1988 and along with a third field comprised a 160-acre block. Both fields were approximately 2600 feet wide and 900 feet long containing approximately 54 acres each. The bottom of these two fields bordered a shallow parabolic field ditch. The bottom rice levee in each of these fields paralleled the field ditch. Therefore the seepage from these two fields flowed out this common ditch. The other three sides of each field were enclosed by a permanent levee. Field 2 had 5 cuts with each cut being approximately 200' wide and 2600' long spaced on a .20' fall. Field 1 had 6 cuts with the levees spaced 150' apart on a .15' fall between levees. This narrower levee spacing serves to conserve water. Field 1 was also set up with a side inlet system (this system is described elsewhere in this report).

The water source for both fields was a groundwater well with water supplied to each field through an underground pipeline outletting through a riser in the top of each field. Each riser was equipped with a flow meter to measure the flow into the respective fields. The flow meters were in their own pipe section with flow straightening vanes, and a sufficient length downstream from the well discharge.

At the outlet points, rectangular-notch weirs were installed to measure the quantity of runoff. The stage-discharge relationship for the weirs gives the flow through the weir if the head on the weir is known. Stage recorders were installed with the weirs to measure water depth in the field (head) in relation to the weir.

Field 3 was a non-leveled 80-acre field. The inflow and outflow were measured as in fields 1 and 2. Field 3 was bound by permanent levees on the north and east but had pulled levees on the west and south bordering a road ditch. No new management practices were installed in this field.

Field 4 was approximately 70 acres in size with a width of 1300' and a length of 2600'. Inflow and outflow again were recorded in the manner used in the other fields. Management practices installed in this field included narrow levee spacing (.15' fall) and the side inlet system.

The spring was very dry with drought conditions existing in May and June. The hot dry weather required these fields to be flushed 2 to 4 times to establish a stand. No attempt was made to measure the runoff from these flushes due to the problems in measuring the high rate of runoff required to remove a flush in a timely fashion. The final runoff from draining the field prior to harvest was not measured for this same reason. Therefore only water use during the "flood" period is reported.

The fields were planted by drill beginning in mid April with flushing beginning soon after and continuing until mid-June at which time permanent floods were established in all fields. The flood season water balance is summarized in Table I. The atmometer gives an estimate of evapotranspiration from a crop. For rice with a free water surface the water use would be greater than the atmometer readings. However the atmometer provides a relative measure of evaporative demand differences from field to field and from year to year.

Table I.

Field No.	pumpage	outflow	rain in./acre	atmometer
1	13.5/a	2.4	6.4	12.5
2	32.0	0.9	6.4	12.5
3	25.6	4.2	9.7	14.3
4	40.6/c	11.5/b	11.0	16.8

a/ total inflow not recorded
b/ drainage from another field's flush included
c/ estimate from hours pumped and measured flow rate

The results of the four fields shown in Table I cannot be compared directly due to variables such as levee seepage. However additional information on the physical aspects of the field allows a better comparison to be made. Fields 1 and 2 each had 2600' of exterior, pull-up levee. Seepage through this type levee when on the exterior of the field may be a considerable component of the water loss from these fields. The amount of this seepage was measured and is documented elsewhere in this report. The negligible outflow from these fields through the measurement weirs was masked by the seepage through the levees. Field 3 also had a great length of exterior rice levees which seeped throughout the flood period. While a negligible amount of water flowed through the weirs, the outflow from the rice fields can be considerable when seepage is considered. Field 4 was the opposite situation. This field was surrounded on all four sides by a permanent levee through which no seepage occurs. Water either left the field through transpiration, evaporation, or through the weir. Thus while Table I would indicate that field 4 was the more inefficient, if all levee seepage could be measured then the results would probably change. All results indicate that these cooperators manage their water so that the only major water loss through their outlet gate is rainwater.

Field 4 had very good records kept by the cooperator. Following is a summary of the data, providing an overview of a typical field management situation.

Field 4 was 70 acres in size and had a Sharkey clay soil. The field had been precision leveled in 1985 on a tenth foot per hundred foot grade. Rice was grown on the field in 1986 and soybeans in 1987. Seedbed preparation for 1988 was as follows: tilled and landplaned, fall 1987; 3 pts. Gramoxone, April 3, 1988; field cultivate, 2x, April 28; and drag pipe, May 3. The field had cuts spaced on a .15' interval which resulted in 16 cuts in the field. Metal rice gates were used in the field.

Planting was done on May 4 by grain drill on a 10" spacing. The cultivar was Lemont at a seeding rate of 95 lbs/acre. The first flush occurred May 12-15. Seedling emergence occurred on May 21 with first leaf occurring May 23. The second flush occurred June 13. The permanent flood was established June 16-21. From planting until permanent flood was established the field received 1.5" of rain. Panicle differentiation (as determined by 1/2" internode) occurred July 13. Various fertilizers, herbicides, fungicides, and insecticides were applied to the field from May 31 to August 12. The field was drained September 9, 1988, harvested on September 25, and had a yield of 162 bu/ac. Residue was rolled and then the outlet riser boarded to allow the field to flood for winter waterfowl habitat. The field will be drained March 1, 1989. From the start of the growing season until July 9, the water table showed a six foot drawdown (20' to 26').

LEVEE SEEPAGE

As was noted earlier, a field ditch ran between the bottom levees of fields 1 and 2 (see Figure 1). The rice levees were each 2600' long with their seepage providing the only input to this ditch other than the rain that fell directly into the ditch. After permanent flood was established it was observed that the ditch was constantly flowing, and had at times a high flow rate. One of the cooperators had suggested that the SCS monitor levee seepage so the opportunity was taken. Due to equipment shortages and limitations a Parshall flume was installed in the ditch bottom with a stage recorder located upstream to measure the flow. The flume was upstream of where the weirs entered the ditch so the flume measured only seep water and rainfall into the ditch.

Flows at time breached the constructed dam to direct flow through the weir so that the recorded flows of water were lower than actual. Breaches occurred both after rains and under high seepage flows when fields were pumped up. The seepage results are shown in Table II. The total flow recorded was 13.4 million gallons after the rainfall into the ditch itself was subtracted. Seepage would be made up of water from irrigation and water from rainfall but it is impossible to determine the individual percentage of contribution. Since 106 acres of land were contributing seepage to this ditch, the seepage was 4.8 inches per acre for the two fields. A typical irrigation pump would require approximately 300 gallons of diesel fuel to pump this quantity of water. Since 275,000 acres of rice were planted in 1988, enclosing rice fields with permanent levees to eliminate seepage would have achieved additional fuel savings.

Table II

Seepage Results

Seepage losses	13.4 Mgal
4.8 inches of water on 106 acres	
pumping costs: 300 gal diesel, $165	

CONCLUSIONS

Management practices were installed on fields 1 and 4 to evaluate the effectiveness in conserving irrigation water and the energy required to pump it. These techniques included narrower levee spacing to reduce the water impounded on the field and multiple side inlets to allow more beneficial use of rainfall and to provide for more efficient water delivery within the field.

Using multiple side inlets allows water to be provided to cuts individually or in groups of 2 to 3 rather than water being provided to the entire field through the top cut. The side lateral requires gates so the field as a whole requires more gates. Having more gates means more management and labor input. However, once the system is understood management and labor requirements should be no more rigorous than present management systems. Instead of a lateral rigid plastic or collapsible irrigation pipe could be used to transport water to the cuts. A costly but easy to operate system would be an underground line with risers to several cuts. The objective is to apply only the water the cut needs and to allow freeboard for the utilization of rainfall. Each acre-inch of water saved is 27,000 gallons and requires 0.6 gallons of diesel fuel to pump.

Direct comparison of field water use was impossible due to field variables (permanent versus pull-up levees, insufficient water supply). Some of the observed field management problems (field 4 had too many gates) and equipment problems (clogged flow meters, rice gates to small for flow required) will be addressed this coming year. Also instead of using a lateral in the field, rigid plastic irrigation pipe will be used to deliver water to individual cuts. However problems like these arise in any new management practice and the lessons learned from this season will be applied to next season (inlets into every other cut from a side lateral). All four of these fields do indicate that with the exception of rainfall and seepage, rice farmers can virtually eliminate any runoff. If 4 inches of rainfall (or seepage losses) that would normally run off could be utilized on the fields, the pumping requirement could be reduced 4". On Fields 1 and 2, pumping 4" less (or 11.4 million gallons total) would have saved approximately 250 gallons of diesel fuel.

RECOMMENDATION FOR IMPROVED WATER MANAGEMENT EFFICIENCY

Not every farmer or farm manager has the dedication and diligence, know how and information, time and labor to manage irrigation at its highest efficiency. Therefore it is important that the management job is made as easy and uncomplicated as possible. The following is an outline for a rice water management plan that includes management practices which can increase irrigation efficiency. Full descriptions of the outline components are available at local Soil Conservation Service offices.

Rice Irrigation Water Management Plan

- A. Shallow water management
  1. Shallow flood
  2. Levee spacing
  3. Multiple inlets
  4. Precision leveling
- B. Water delivery systems
  1. Multiple inlets
  2. Underground pipelines
  3. Reducing lateral water loss
  4. Improving pumping plant efficiency
  5. Measuring water flow
- C. Flushing
- D. Field records
- E. Tailwater Recovery
- F. Winter Waterfowl Habitat

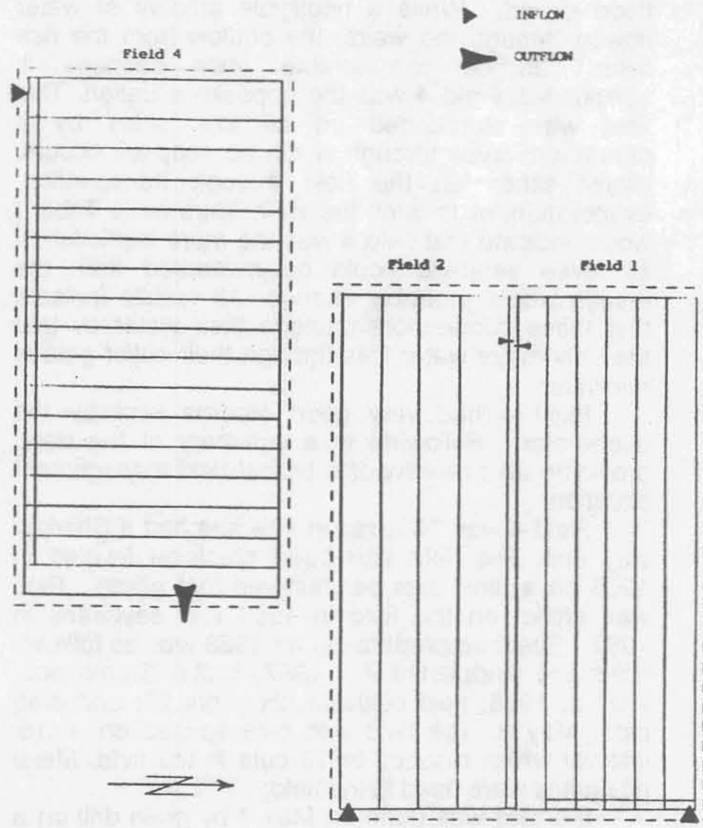

Figure 1. Field Layout

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