CONSIDERATIONS WHEN CONVERTING FROM FLOOD TO PIVOT IRRIGATION

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Irrigated land expansion has been stable or declining due to the lack of additional water resources, yet acres irrigated by center pivots continue to increase. New emphasis on water conservation and irrigation efficiency through both economic pressures and institutional constraints may be partially responsible for the increase in pivot acreage through the conversion of flood ground. Many flood systems due to design and operation do have low irrigation efficiency. Low irrigation efficiency results in systems needing high irrigation capacity and in wastes of energy resources for pumping. Labor availability in many instances favor a conversion of flood irrigated land to pivot irrigated land. These are some of the consideration an irrigator must weigh when determining whether switching from flood to pivot irrigation would be desirable.

Irrigation System Capacity

Irrigation systems that are considered high capacity have the net capability to supply water at rates similar to the average peak crop water use rate, which is often considered to be around 0.25 inches/day per acre. Daily peak crop use rates can be in excess of 0.50 inches/day so even high capacity systems must depend on soil water reserves during these extreme peaks. The total system capacity requirement would then be dependent on total acres irrigated and irrigation system efficiency. Table 1 shows the required irrigation system capacity for various acreage and system efficiencies.

Table 1: Irrigation System Capacity Requirements to Supply 0.25 inches/day for various irrigation efficiencies and acreage.

	Irrigation System Capacity (GPM)		
Irrigation System Efficiency	Acres Irrigated 1	128	160
100%	4.69	600	750
90%	5.21	667	833
80%	5.86	760	938
70%	6.70	857	1071
60%	7.81	1000	1250
50%	9.38	1200	1500

Flood irrigation systems were traditionally set up with irrigation system capacity approaching 10 gpm/acre, meaning the expected irrigation efficiency was probably less than 50%. Management, design, and technology improvements have increased flood irrigation efficiency but irrigation capacity for a full quarter section is still generally in excess of 1000 gpm because of large acreage and low efficiency. Regional water table declines have, in many instances, decreased well capacities that below the needed capacity at current irrigation efficiency. Although the flood irrigation has acreage flexibility, loss of capacity may be an important factor in considering an irrigation system upgrade, which could involve a conversion to center pivot. However, conversion to center pivot may not be the only option when considering an irrigation system upgrade.

Labor Requirements for Irrigation Systems

Every irrigation system have a certain amount of labor requirement for operation, management and maintenance. Labor requirements can be a major cost associated with irrigation systems. The timing of the labor requirement in relationship to labor availability and other work schedules is important as well. The individual irrigation considering conversion to a center pivot system from flood irrigation would have a personal historical record of labor requirement of the flood system. Labor requirements for system operation have been estimated as 1.1 hours/acre/1000 hours of operation for gated pipe and .5 hours/acre/1000 hours of operation for center pivots. (Powell 1990). These figures indicate seasonal operational labor requirements for center pivots may be less than half that of flood systems.

Irrigation Investment Cost

The cost of money is an important factor in every investment consideration. The investment cost can be either the interest rate charged for any loans taken to purchase equipment or the rate of return forfeited if cash on hand is used for the purchase. The equipment investments that need consideration, in addition to the center pivot itself, are the underground pipe and modification of the pumping plant. Table 2 presents a series of capital recovery factors. Capital recovery factors, when multiplied by the current investment cost, will annualize the investment cost for the selected interest rate and life of loan or equipment. Any previous investment which has not been paid off must be added to any new investment cost.

Table 2. Capital Recovery Factors for Various Interest Rates and Length of Loans

Life of Loan Years	Interest Rate 5%	8%	12%	15%
3	.3672	.3880	.4163	.4380
6	.1970	.2163	.2432	.2642
9	.1407	.1601	.1877	.2096
12	.1128	.1327	.1614	.1845
15	.0963	.1168	.1468	.1710

Pumping Plant Conversion Cost

Changing the irrigation system from flood to center pivot can result in a drastic change in the diversion rate and pressure requirement that must be provided by the pumping plant. The effect on pumping efficiency can be substantial. There could also be enough change in water horsepower requirement to require a different power unit. Completely redesigning the pumping plant can be a substantial investment. The effect of changing pumping conditions on pumping plant efficiency is more fully discussed in other sessions.

Underground Electrical and Water Supply Service

Underground supply pipe is also a major expense in converting flood to pivot. Given the option of well location, flood systems generally have wells located at the top edge of the field. This requires underground service pipe to be installed to the pivot point. Generally, underground electrical service is also required.

Center Pivot

A variety of center pivot systems with various package options are available for selection by the irrigator. These can be designed for the specific needs and preferences of the irrigator and field conditions.

Economic Analysis

Assume the total conversion cost for pumping plant modification, underground pipe and center pivot system requires an investment of $50,000 and the entire purchase if financed for twelve years at twelve percent interest. The capital recovery factor from Table 2 for these conditions is .1614. Annual investment cost would then be .1614 x 50,000 equal to $8,070. Taxes and insurance would be in addition to this cost.

Table 3 is a compilation of expenses and savings associated with switching to a center pivot. The figures shown for this example indicate what conversion to a center pivot would cost the individual for the assumptions given. Yield levels and land irrigated are assumed equal for both systems. In this example the conversion to a center pivot system would add $7295.00 of annual irrigation cost.

Table 3: Expenses and Savings associated with Center Pivot ownership and operation versus flood irrigation.

Item	Cost (-)	Saving (+)
Pivot annualized investment cost	-	$8070
Maintenance and Repair*	-	1600
Labor Requirements+	+	985
Pumping Energy **	+	350
Farming Practices++	+	1040
	-	$7295

* Assumed .05 of initial investment of center pivot. Maintenance of pumping plant and underground assumed equal for either systems.

+ Assuming 22"/year flood application and 16"/year pivot application at 750 gpm. Labor estimates: 1716 hours flood; 1248 hours pivot. $6.00/hour labor.

** Assuming pumping plant performance at Nebraska Performance Criterion and 25 psi additional system pressure for pivot.

++ Reduced tillage may be easier under pivot system. One operation estimated as $8/acre savings for omitting one tillage operation.

References

Powell, T.A., 1990. Annual Irrigation Costs. Proceedings of the Nebraska Irrigation Short Course. University of Nebraska-Lincoln. Agricultural Engineering "Irrigation" No. 24. Pg 52-69.