ECONOMICS OF CONVERSION FROM FLOOD TO PIVOT

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A number of factors generate producer interest in changing or modifying their irrigation systems. In addition to continual pressure to reduce costs, producers are increasingly facing concerns to reduce water use and the associated leaching of nitrogen. Also, a desire to increase operator output and convenience are often major considerations when looking at alternatives. The availability of funds to invest in system changes and the failure of system components can also prompt a look at the alternatives.

The purpose of the discussion here is to focus upon the budgeting of continued operation of a flood irrigation system versus switching to a pivot. The effect upon labor demands will be considered although evaluating the impact of switching to pivots upon potential size of farm and family income is beyond the scope of this paper.

Current System Costs

Continuing to operate the current system will involve operating costs (fuel, lube, repairs, and labor) with replacements made as and when needed with consequent additional ownership costs (depreciation and interest on the investment). There may also be some financing arrangements for the current system that involve current debt payments. The interest portion of these payments should be determined in case the interest rate on the new system is different. Any taxes or insurance premiums associated with the current system should also be determined.

The example budgeted costs of owning and operating a flood system with a well as its source of water are presented in Tables 1 and 2. For an established system, the budgeted annual ownership costs represent the annual revenue that is needed to replace components as needed assuming the budgeted costs are updated each year to reflect current prices. However, for any given year it would be profitable to continue to operate the system as long as the operating costs are covered. It would be most profitable to abandon the system if over time it would not be expected to generate enough revenue to cover the operating costs plus the annual return that could be expected from investing the funds realized from the sale of the equipment (or the returns from using the equipment elsewhere) net of any costs to deactivate the system (cap the well, for example). The net realized annually including operating costs saved from abandoning the system will be called its salvage cost. Alternatively, it would be most profitable to replace the system if the annual cost of the replacement system is below the salvage cost of the existing system.

To illustrate an extreme example, consider a situation where if the existing system were abandoned or replaced, the well would be capped and the value of the components salvaged equals the cost of shutting down the well. The salvage cost of the existing system would then be the cost of operating the system (repairs, duel, and labor). The alternative system would then have to have an annual ownership and operating cost that is less than the operating cost of the existing

Figure 7: Pumping Cost For Various Fuel Prices and Head Requirements.

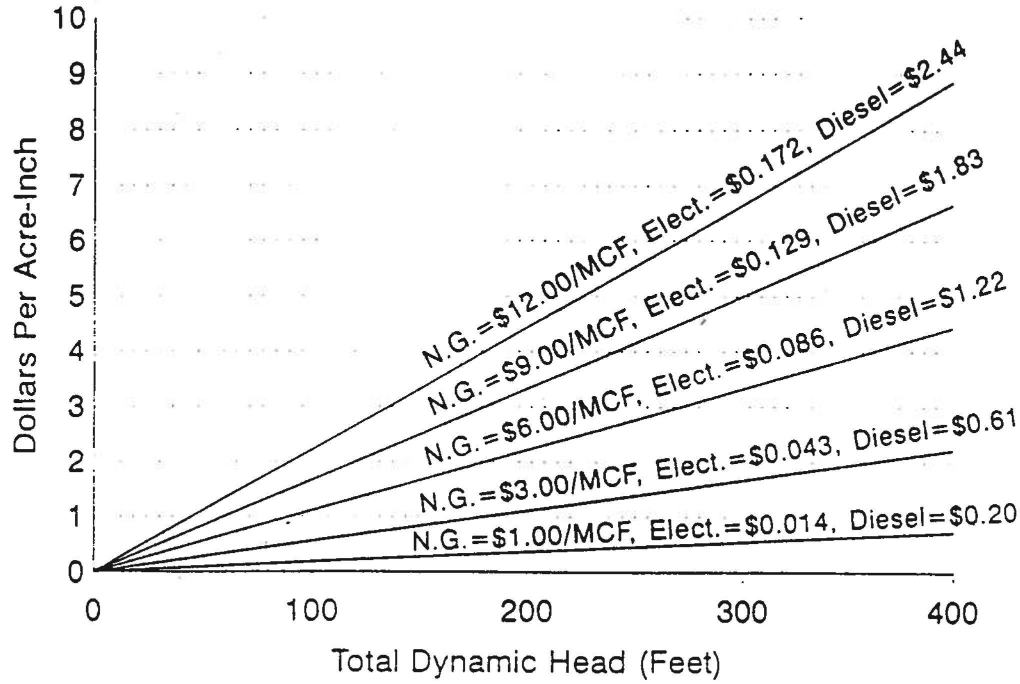
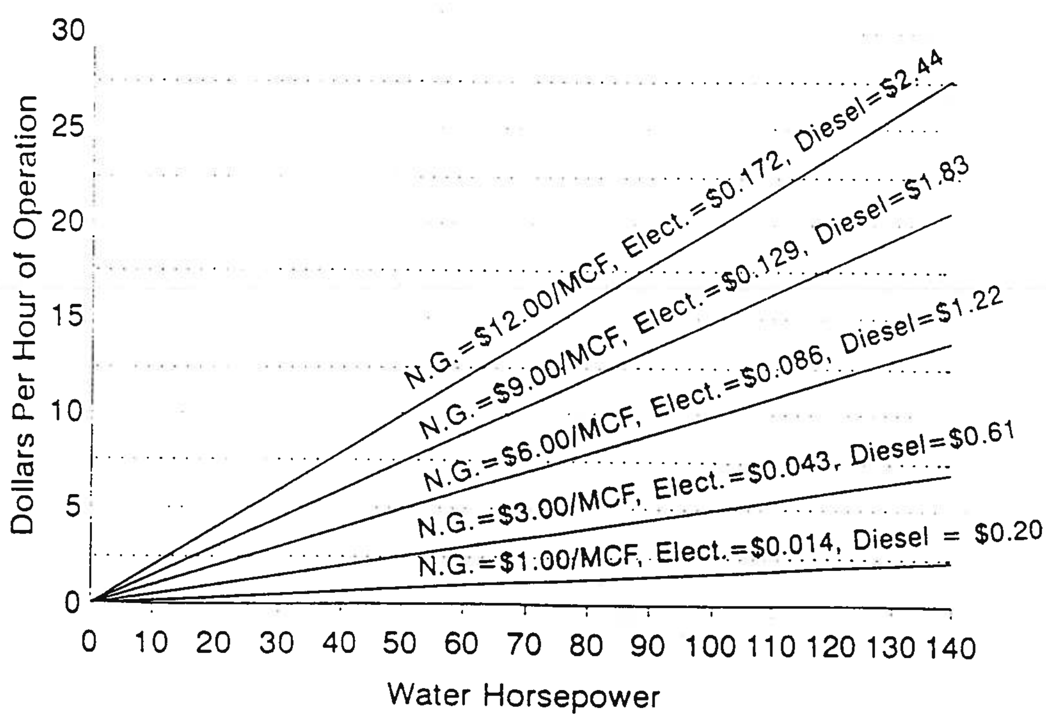


Figure 8: Hourly Irrigation Pumping Cost for Various Fuel Prices and Water Horsepower Requirements.



system to be least-cost. It is entirely possible that the existing system remains least-cost until some of it components fail and need to be replaced to continue operation. If the system is maintained and components replaced as in Table 1, the estimated average annual ownership costs are $44.88 as shown in Table 1. Although it may be least-cost to delay switching systems until replacement of a major component is required, it would be least-cost to eventually replace the existing system if the ownership and operating costs of the alternative system are less than the ownership and operating costs of the existing system. Replacing a flood system with a pivot, however, has the added complication that the pivot typically leaves some acreage unirrigated. We will first consider some possible field configurations and their effect on pivot investment and then return to considering switching from a flood to a pivot system.

Table 1. Example flood system investment and annual ownership costs.

	New Cost	Years Useful Life	Annual Cost/Acre[1]
Well			$26.81
Well (250')	$12,543	25	
Column Pipe (200')	8,160	18	
Fuel tank, filter, fuel line	2,160	20	
Leveling/shaping	20,000	50	
Pump base	1,663	25	
Pump			4.32
Bowls	2,898	18	
Gearhead and spicer shaft	2,085	15	
Power unit (diesel)	7,130	12	7.87
Delivery System			5.87
Pipe (2,970 ft.) and fittings	5,643	15	
Pipe trailer	800	20	
TOTAL	$63,082		$44.88

[1] Annual depreciation plus *real* interest (net of inflation) at a 5% annual rate, 100 acres.

Table 2. Example flood system operating costs.

Repairs per acre foot		$ 4.31
Fuel and oil per acre foot		12.86
		$17.17
	Acre feet	2
Fuel and repairs, 2 acre feet		$34.34
5 irrigations @ 0.3 hours labor @ $7/hour		10.50
Annual Operating Costs per Acre		$44.84

Center Pivot System Designs and Costs

Center pivot system capital requirements for alternative field scenarios are given in Table 3. The center pivot system costs were estimated using private industry cost figures and input from agricultural engineers. These were reported in the proceedings of the 1997 short course. The field radius represents the length of underground pipe needed. Worksheets presented in the KSU Extension publication, *Irrigation Capital Requirements and Energy Costs,* MF-836, are used as an investment analysis framework. Further explanation is given in footnotes to Table 3.

The Total Cost Per Acre column in Table 3 illustrates the higher capital cost per acre as center pivots are placed on successively smaller fields. For base Scenario A, total irrigation system investment cost is $326 per acre. Total investment increases from $326 per acre for a full 125 acre pivot circle to $978 per acre in scenario E (25 irrigated acres). The wiper system (Scenario F) cost is $532 per acre for 64 irrigated acres, or $34,527 approximately equal to the $34,050 for the centrally located pivot in Scenario C.

Table 3. Center Pivot System Capital Requirements for Alternative Field Sizes.

Center Pivot Field				Center Pivot System Cost[1] per Irrigated Acre				
Field Scenario	No. Pivot Acres	Dryland Corner Acres	Total Acres	Pivot System Cost	Field Radius	Pipe, Wiring, Electric[2]	Total Cost	Total Cost/ Acre[3]
Full Circle[4]								
A	125 ac	35 ac	160 ac	$31,500	1320 ft	$9,282	$40,782	$326/ac
B	100 ac	27 ac	127 ac	$29,400	1177 ft	$8,548	$37,948	$379/ac
C	75 ac	20 ac	95 ac	$26,775	1020 ft	$7,752	$34,527	$460/ac
D	50 ac	14 ac	64 ac	$23,100	832 ft	$6,809	$29,909	$598/ac
E	25 ac	7 ac	32 ac	$18,900	589 ft	$5,559	$24,459	$978/ac
F "Wiper"[5]	64 ac	16 ac	80 ac	$31,500	1320 ft	$2,550	$34,050	$532/ac

1 Cost in this table refers to initial investment cost.
2 8" underground pipe @ $3/ft, connectors @ $350, electric wiring @ $2.10/ft, 12 kVA generator @ $2,200.
3 No interest cost included. Calculated on a per irrigated acre basis.
4 Pivot makes a full circle in a square field in Scenarios A-E.
5 Pivot is centered on one side of a rectangular field and makes a half circle.

Switching to a Pivot

How does the cost of irrigating at 125 foot lift with a diesel gravity system compare with using a diesel center pivot system?

This comparison requires some assumptions on the area to be irrigated and the efficiency of application for the two systems. In the comparison made here, we consider two gravity systems serving 80 acres each versus one center pivot serving 130 acres with 30 acres remaining dryland. Crop water use is 12 AI. The yield from irrigated acres is assumed the same for both systems.

These data suggest the gain from irrigating the additional 30 acres does not cover the additional costs ($2,820 gain vs. $3,713 added costs). This result will depend upon a number of factors including the number of acres each system serves.

Table 4. Flood vs Pivot System.

	Flood	Pivot	
Irrigated Acres	160	130	
Head	148 ft	206 ft.	
Application Efficiency	50%	95%	
Acre-Inches pumped/acre	24	12.6	
GPM	1,000	800	
Pumping hours	1,728	921	
Repairs/hour	$0.80	$1.16	
Fuel and lube/hour	$2.39	$2.84	
Operator labor, hours/acre	1.5	0.4	
Annual Irrigation Costs			
Interest	$3,226	$2,596	
Depreciation	5,514	5,575	
Repairs	1,382	1,068	
Fuel and lube	4,130	2,616	Gravity
Labor @ $7/hour	1,680	364	Added Costs
Total	$15,932	$12,219	$3,713
Pivot Corners	Gravity	Dryland	
Corn yield (bu)	145	65	
Price/bu	$2.25	$2.25	
Revenue/acre	$326	$146	
Operating cost/acre	166	80	
Net/acre	160	66	Gravity Gain
30 Acres	$4,800	$1,980	$2,820