KANSAS FARM MANAGEMENT & MARKETING HANDBOOK

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Irrigation Capital Requirements and Energy Costs

Department of Agricultural Economics

K-STATE Kansas State University

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Daniel O'Brien
Extension Agricultural Economist, N.W.

Troy J. Dumler
Extension Agricultural Economist, S.W.

Irrigation allows producers to grow high volume crops that otherwise would not be possible due to low rainfall. In addition, the weather related production risk associated with those crops is reduced. However, producers must weigh the costs of irrigating with the benefits received. Irrigation costs will vary depending on well depth, delivery system, energy costs, and management ability.

Table 1 outlines average capital requirements for those items other than the actual delivery system. These costs will be similar for the different types of irrigation systems. Irrigated land values often include the well, pump and gearhead in the per acre cost. It is beneficial to break this value down into the individual components for budgeting purposes. Also, the well, pump and gearhead costs will generally be the same regardless of how many acres are irrigated. Thus, the well and pump and gearhead per acre costs change as the amount of irrigated acres increase or decrease.

The value of irrigated land will vary depending on slope and soil type. Flood and drip systems require a relatively flat field whereas pivot systems can operate on rougher terrain. The cost of the well was based on a 300-foot well, while the cost of the pump and gearhead was based on an 8-inch pump at a 245-foot setting. The motor cost was based on the power required given the depth of the well and the pump used. A natural gas power unit was assumed in these calculations. These costs will increase as the depth and capacity of the well is increased.

Table 1. Irrigation Capital Requirements for Land, Well, Pump-Gearhead, and Power Unit

Item	Budgeted Total	Flood Irrigated 160 acres	Center Pivot 126 acres	Your Farm Total	Your Farm Per Acre
		$ Per Acre			
Land*	XXXXX	$ 754.00	$ 687.00	_____	_____
Well	$19,000	118.75	150.79	_____	_____
Pump & Gearhead	21,000	131.25	166.67	_____	_____
Power Unit—Natural Gas**	4,200	26.25	33.33	_____	_____
Water Meter	1,000	6.25	7.94	_____	_____
Connectors	750	4.69	5.95	_____	_____
Total per Irrigated Acre		$ 1,041.19	$ 1,051.68	_____	_____

**Land values are shown for yield level II in the irrigated crop budgets.*

***Estimates range from $3,800 to $4,500. Alternatively, diesel power units cost approximately $7,000.*

Irrigation Delivery Systems

The type of irrigation delivery system used will have a big impact on the total investment cost. Tables 2, 3, and 4 list average costs of center pivot, flood irrigation (gated pipe), and drip irrigation. While flood and center pivot irrigation systems are very common in Kansas, drip irrigation is relatively new. The costs of each irrigation system are based on a quarter section of land with the well centrally located at the edge of the field.

There are many factors to consider when comparing the different systems in addition to total investment costs. Some of these are:

1. Available capital,
2. Labor available during growing season,
3. Well capacity,
4. Topography of the field,
5. Soil type.
6. Pumping cost; and
7. Management expertise relative to each type of irrigation system.

The investment cost of flood irrigation is significantly lower than center pivot or drip systems. However, labor requirements can be as much as 1 hour/acre less for a sprinkler system compared to flood irrigation. Well capacity and application efficiencies also need to be considered. Research indicates application efficiency with flood irrigation is generally in the range of 50 to 75 percent depending on management abilities.

This application efficiency compares to a range of 75 to 95 percent for center pivot and approximately 99 percent with drip. Therefore, a more efficient system may increase yields and/or allow for more acres to be irrigated from the same well if managed properly.

Topography also can dictate which system is used. Both flood and drip systems require relatively flat land, whereas pivots can be used on uneven terrain. The more efficient systems will also realize larger savings from less water pumped if pumping costs are high. While hard to measure, the producer's management expertise with a particular irrigation system is one of the more important factors to consider when making a irrigation system investment.

Table 2. Capital Requirements: Center Pivot Irrigation System (126 acres)

Item	Feet	Price/ft	Costs	Total	Your Farm Total
Standard 7 Tower Pivot*					
System Base Price**	1,320		$28,000		_____
Drops on 80" Spacing			2,100		_____
Low Drift Nozzles			2,400		_____
38" x 11.2 Tires			3,000		_____
Sprinkler System Total**				$35,500	_____
8" Underground Pipe***	1,320	$ 2.52	3,326		_____
Electrical Wiring****	1,320	$ 1.90	2,508		_____
Connectors			1,500		_____
12 KVA Generator******			2,375		_____
Total Pipe, Electrical, etc.				$9,709	_____
Total Cost of CP System				$ 45,209	_____
System Costs Per Irrigated Acre				$ 358.80	_____

**Most new center pivot systems have seven towers rather than eight. **The System Base Price varied from $27,500 to $28,500, with total system costs varying from $35,000 to $36,000. ***8" underground pipe cost estimates varied from $2.45 to $2.58 per foot. ****Electrical wiring cost estimates varied from $1.70 to $2.20 per foot. *****12 KVA Generator cost estimates varied from $2,200 to $2,550 per unit.*

Table 3. Capital Requirements: Flood Irrigation System (160 acres)

Item	Feet	Price/ft	Costs	Total	Your Farm Total
Gated Pipe*	2,640	$ 1.30	$ 3,432	$ 3,432	_____
Surge Valve**			1,675	$ 1,675	_____
Connectors			150	$ 150	_____
Total Cost of Flood System				$ 5,257	_____
System Costs Per Irrigated Acre				$ 32.86	_____

**The gated pipe price represents used pipe. The price of new aluminum gated pipe ranged from $3.00 to $3.58 per foot, and the price of new plastic gated pipe ranged from $1.50 to $2.08 per foot. ** The surge valve ranged from $1,650 to $1,700 per valve.*

Table 4. Capital Requirements: Drip Irrigation System (160 acres)*

Item	Feet or items	Price	Costs	Total	Your Farm Total
8" Mainline Pipe	4,620 ft	$1.30	$ 6,000		_____
6" Lateral Submain Pipe	1,360 ft	$0.75	1,020		_____
4" Flushline Pipe	11,840 ft	$0.60	7,104		_____
Driptape	1,399,200 ft	$0.03	41,976		_____
Driptape connectors (supply tubing & sleeve locks)			3,168		_____
8×8×8×8 Crosses	2	$200	400		_____
8" PVC wafer butterfly valves	4	$400	1,760		_____
8-6" PVC reducers	4	$25	100		_____
6-4" PVC reducers	4	$20	80		_____
4" PVC elbows	12	$30	360		_____
4-2" Reducing Bushing	12	$18	216		_____
2' Plugs	12	$6	72		_____
Air Vents	14	$25	350		
PVC glue and solvent			250		_____
Filter—900 GPM, automated sand media			4,500		_____
Pressure Gauges (0-30 PSI)	18	$20	360		_____
Trenching	15,179 ft	$0.68	10,322		_____
Producer Labor	900 hr	$8.00	7,200		_____
Producer Provided Tractor	138 hr	$7.00	966		_____
Total Cost of SDI System				$ 86,210	_____
System Costs Per Irrigated Acre				$ 538.81	_____

**These SDI installation budgets reflect 1998 costs and recommended equipment. For updated SDI design recommendations and cost estimates, please contact Dan Rogers, Extension Irrigation Engineer, or Dan O'Brien, Extension Agricultural Economist.*

Table 5 compares the total investment required for a quarter of land and all irrigation equipment for center pivot, flood and drip systems. The land cost with a center pivot system is adjusted to include the cost of the nonirrigated corners. While the total cost of the flood and center pivot do not differ greatly, the number of acres to be irrigated needs to be considered.

Table 5. Capital Requirements by Irrigation System

Acres = = >	126		160		160	
Item	Center Pivot		Flood		Drip System	
	/Ac.	/Qtr.	/Ac.	/Qtr.	/Ac.	/Qtr.
Land	$ 687.00	$ 86,562	$ 754.00	$ 120,640	$ 754.00	$ 120,640
Well	150.79	19,000	118.75	19,000	118.75	19,000
Pump & Gearhead	166.67	21,000	131.25	21,000	131.25	21,000
Power Unit	33.33	4,200	26.25	4,200	26.25	4,200
Water Meter	7.94	1,000	6.25	1,000	6.25	1,000
At Well Connectors	5.95	750	4.69	750	4.69	750
System	358.80	45,209	32.86	5,257	538.81	86,210
Total per Irrigated Acre	$1,410.48		$1,074.04		$1,580.00	
Quarter Adjustment*		$ 16,728				
Total per Quarter		$194,449		$171,847		$252,800
Total per Acre	$1,215.31		$ 1,074.04		$1,580.00	

**Adjustment is for value of nonirrigated corners associated with center pivot systems.*

Pumping Costs

Energy source, price, and Total Dynamic Head (TDH) are the important facts affecting pumping costs. Total Dynamic Head is determined by the amount of lift, pressure, and any friction losses. Table 6 lists the pumping costs per acre inch at various levels of TDH and different prices of natural gas, diesel, electricity, and propane.

Table 6. Energy Pumping Cost Per Acre Inch*

	Total Dynamic Head (TDH)**						
	100	200	300	400	500	600	700
Natural Gas ($/mcf)							
$2.00	0.49	0.99	1.48	1.98	2.47	2.97	3.46
$3.00	0.74	1.48	2.22	2.97	3.71	4.45	5.19
$4.00	0.99	1.98	2.97	3.96	4.94	5.93	6.92
$5.00	1.24	2.48	3.72	4.96	6.20	7.44	8.68
Diesel ($/gal)							
$0.50	0.61	1.22	1.83	2.44	3.05	3.66	4.27
$0.75	0.92	1.83	2.75	3.66	4.58	5.49	6.41
$1.00	1.22	2.44	3.66	4.88	6.10	7.32	8.54
$1.25	1.53	3.05	4.58	6.10	7.63	9.15	10.68
Electricity ($/KWH)							
$0.04	0.69	1.38	2.07	2.76	3.45	4.14	4.83
$0.06	1.03	2.07	3.10	4.14	5.17	6.20	7.24
$0.08	1.38	2.76	4.14	5.52	6.89	8.27	9.65
$0.10	1.72	3.45	5.17	6.89	8.62	10.34	12.06
Propane ($/gal)							
$0.40	0.89	1.77	2.66	3.54	4.43	5.31	6.20
$0.65	1.44	2.88	4.32	5.76	7.19	8.63	10.07
$0.90	1.99	3.98	5.98	7.97	9.96	11.95	13.95
$1.15	2.55	5.09	7.64	10.18	12.73	15.28	17.82

**Basis for fuel calculations at Nebraska Pumping Plant Criteria of 75% efficiency. Pump efficiency is assumed to be 75%.*
***TDH = Feet lift + (2.31 × PSI)+ Friction losses.*

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