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 M. O'Brien
Extension Agricultural Economist
N.W.

Troy J. Dumler
Extension Agricultural Economist
S.W.

Danny H. Rogers
Extension Irrigation Engineer

Irrigation allows producers to grow high-volume crops that otherwise would not be possible due to low rainfall. The weather-related production risk associated with those crops is reduced, but producers must weigh the costs of irrigating with the benefits received. Irrigation costs 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 irrigation 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 individual components for budgeting purposes. Also, the well, pump, and gearhead costs generally will be the same regardless of how many acres are irrigated. Thus, the well, 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 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 type of pump used. A natural gas power unit was assumed in these calculations. These costs will increase with depth and capacity of the well.

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	$ 764.00	$ 697.00	_____	_____
Well	$19,000	118.75	150.75	_____	_____
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		$ 1,051.19	$ 1,061.64	_____	_____

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

Irrigation Delivery Systems

The type of irrigated delivery system used will have a large 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 cost of each irrigation system is based on a quarter section of land with a well centrally located at the edge of the field.

In addition to total investment costs, factors to consider when comparing the different systems include:

1. Available capital;
2. Labor availability during the 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 per acre less for a sprinkler system compared to flood irrigation. Well capacity and application efficiencies also should be considered. Research indicates application efficiency with flood irrigation is generally in the range of 50 to 75 percent, depending on management abilities.

Application efficiency of flood irrigation systems compares to a range of 75 to 95 percent for center pivot and approximately 99 percent with drip irrigation systems. Proper management and a more efficient system may increase yields and/or allow more acres to be irrigated from the same well.

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 in making an 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	$ 2.62	3,459		
Electrical Wiring	1,320	$ 2.00	2,640		
Connectors			1,500		
12 KVA Generator			2,375		
Total Pipe, Electrical, etc.				$9,974	
Total Cost of CP System				$ 45,474	
System Costs Per Irrigated Acre				$ 360.91	

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		
Surge Valve			1,675		
Connectors			150		
Total Cost of Flood System				$ 5,257	
System Costs Per Irrigated Acre				$ 32.86	

**The gated pipe price represents used pipe.*

Table 4. Capital Requirements: Drip Irrigation System (160 acres)[a]

Item	Feet or items	Price	Costs	Total	Your Farm Total
8" Mainline Pipe	2,000 ft	$2.80 /ft	$5,600		
8" Submain Pipe	2,640 ft	$2.80 /ft	$7,392		
4" Flushline Pipe	2,640 ft	$1.30 /ft	$3,432		
8" Tee	7	$135 /item	$945		
8" ELL	2	$134 /item	$268		
4" ELL	8	$55 /item	$440		
4" Removable End Caps	75	$75 /item	$600		
8" Butterfly Valves	4	$400 /item	$1,600		
Driptape (11/8" diameter)	1,400,000 ft	$0.05 /ft	$70,000		
Driptape Connectors (supply tubing & sleeve socks)	1,056	$10 /item	$10,560		
Solvent and PVC Glue			$350		
Air Relief Valves	16	$40 /item	$640		
Pressure Gauges	18	$30 /item	$540		
Filter, Injector, & Miscellaneous			$7,000		
Subtotal				$109,367	
Equipment Use (Trenching, Tractor, Subsoiler)			$6,585		
Producer Labor [b]	1,000 hr	$10 /hr	$10,000		
Subtotal				$16,585	
Total Cost of SDI System				$125,952	
System Cost Per Irrigated Acre				$787.20	

[a] These SDI installation budgets reflect recommended equipment for 160 acres with a well located in the top center of the field. This SDI system is designed with 4 irrigation zones to cover the 160-acre field. Cost estimates were provided in October 2000 by Daniel Rogers, Extension Irrigation Engineer.

[b] This budget represents producer installation costs. If commercial installation is used, labor costs may be as much as $10 to $20 per hour and $10,000 to $20,000 per field higher. As a result, the system cost per irrigated acre for a commercially installed SDI system may be in the $850 to $910 per acre range.

Table 5 compares the total investment required for a quarter of land and all irrigation equipment for center pivot, flood, and drip irrigation systems. The land cost with a center pivot system is adjusted to include the cost of nonirrigated corners. While the total cost of the flood and center pivot irrigation systems do not differ greatly, the number of acres to be irrigated should 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	$697.00	$87,822	$764.00	$122,240	$764.00	$122,240
Well	150.75	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	360.91	45,475	32.86	5,257	787.20	125,952
Total per Irrigated Acre	$1,422.55		$1,084.05		$1,838.39	
Quarter Adjustment *		$16,932				
Total per Quarter		$196,179		$173,447		$294,142
Total per Acre	$1,226.12		$1,084.05		$1,838.39	

** 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 factors 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

* *The basis for fuel calculation is at 75% of Nebraska Pumping Plant Criteria efficiency ratings. Irrigation pumps are assumed to be 75% efficient.*

** *TDH = Feet lift + (2.31 × PSI) + Friction Losses.*

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