Irrigation Capital Requirements and Energy Costs

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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 also reduced. Irrigation costs vary depending on well depth, delivery system, energy costs, and management ability. Producers must weigh the costs of irrigating with the benefits received.

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 the individual components for budgeting purposes. Total well, pump and gearhead costs will generally be the same regardless of how many acres are irrigated, but will change on a per acre basis 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 fields whereas pivot systems can operate on rougher terrain. The cost of the well is based on a 300 foot well, while the cost of the pump and gearhead is based on an 8 inch pump at a 245-foot setting. The motor cost is based on the power required given the depth of the well and type of pump used. A natural gas power unit is assumed in these calculations. These costs will increase as depth and capacity of the well is increased.

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

Item	Budgeted Total	Flood Irrigated 155 acres	Center Pivot 125 acres	Your Farm Total	Your Farm Per Acre
		$ Per Acre			
Well	$32,000	$206	$256	_____	_____
Pump & Gearhead	$27,500	$177	$220	_____	_____
Power Unit	$12,500	$81	$100	_____	_____
Water Meter	$1,350	$9	$11	_____	_____
Connectors	$2,500	$16	$20	_____	_____
Total Per Irrigated Acre		$489	$607	_____	_____

Irrigation Delivery Systems

The type of irrigation 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 subsurface drip irrigation (SDI), respectively. While flood and center pivot irrigation systems are common in Kansas, SDI is relatively new. The cost of each irrigation system is based on 155 acres of cropland (i.e., a quarter section of land with 5 acres of roads, waste, etc.) with a 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 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 SDI. However, labor requirements can be as much as 1 hour or more per 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 field characteristics and management abilities.

The application efficiency of flood irrigation systems compares to a range of 75 to 95 percent for center pivot and greater than 95 percent for SDI. 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 SDI 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 (125 Acres)*

Item	Feet	Price/ft	Costs	Total	Your Farm Total
Standard 7-Tower Pivot	1,300 ft		$62,000		_____
System Base Price					_____
Drops on 60" spacing					_____
Low Drift Nozzles			_____		_____
11.2 x 38" tires					_____
Sprinkler System Total [a]				$62,000	_____
8" Underground Pipe	1,300 ft	$3.90 /ft	$5,070		_____
Electrical Wiring	1,300 ft	$3.65 /ft	$4,745		_____
Total Pipe, Electrical, etc.				$9,815	_____
Total Cost of CP System				$71,815	_____
System Cost Per Irrigated Acre				$575	_____

[a] *Additional options can increase price by $1,000 to more than $10,000.*

Table 3. *Capital Requirements: Flood Irrigation System (155 Acres)*

Item	Feet	Price/ft	Costs	Total	Your Farm Total
Gated Pipe [a]	2,640 ft	$1.25 /ft	$3,300		_____
Surge Valve			$1,675		_____
Connectors			$150		_____
Total Cost of Flood System				$5,125	
System Cost Per Irrigated Acre				$33	_____

[a] *Gated pipe price is based on used pipe.*

Table 4. *Capital Requirements: Subsurface Drip Irrigation System (155 Acres)* [a]

Item	Feet or items	Price	Costs	Total	Your Farm Total
10" Mainline Pipe	2,120 ft	$2.73 /ft	$5,788		
8" Submain Pipe	2,880 ft	$2.66 /ft	$7,661		
3" Submain Pipe	2,760 ft	$0.68 /ft	$1,877		
Well Tie Assembly	1	$2,097 /item	$2,097		
8" Meter	1	$1,182 /item	$1,182		
8" Chem Flap Valve	1	$494 /item	$494		
Filter	1	$5,734 /item	$5,734		
Filter Assembly	1	$1,349 /item	$1,349		
Zone Valves	5	$2,659 /item	$13,295		
Mainline Flush Valves	2	$772 /item	$1,544		
Submain Flush Valves	10	$1,449/item	$14,490		
Flushline Valves	10	$813 /item	$8,130		
Miscellaneous Fittings	1	$800 /item	$800		
Injector with Assembly	1	$395 /item	$395		
155 Acres 1⅜" Tape	155	$693 /item	$107,415		
Tape Connections	1	$9,928 /item	$9,928		
Glue and Primer	1	$2,013 /item	$2,013		
Subtotal				$184,192	
Equipment Use (Tractor, Tape Plow Rental)		$35.00/acre	$5,425		
Labor [b]	1,000 hr	$13 /hr	$13,000		
Subtotal				$18,425	
Total Cost of SDI System				$202,617	
System Cost Per Irrigated Acre				$1,307	

[a] *SDI installation budget reflects the recommended equipment for 155 acres with a well located in the top center of the field. This SDI system is designed with four irrigation zones to cover the 155 acre field.*

[b] *This budget represents producer installation costs. If commercial installation is used, labor costs may be higher.*

Table 5 compares the total investment required for all irrigation equipment for center pivot, flood, and SDI systems on a quarter of land. Recent increases in center pivot and drip irrigation systems have pushed investment costs significantly higher than flood systems.

Table 5. *Capital Requirements by Irrigation System*

Item	125-Acre System Center Pivot		155-Acre System Flood		155-Acre System Drip System	
	/a	/125 a	/a	/155 a	/a	/155 a
Well	$ 256	$ 32,000	$ 206	$ 32,000	$ 206	$ 32,000
Pump & Gearhead	220	27,500	177	27,500	177	27,500
Power Unit	100	12,500	81	12,500	81	12,500
Water Meter	11	1,350	9	1,350	9	1,350
Well Connectors	20	2,500	16	2,500	16	2,500
System	575	71,815	33	5,125	1,307	202,617
Total	$1,182	$124,600	$ 522	$ 70,275	$1,796	$278,467

Pumping Costs

Energy source, price, and feet lift are the major factors affecting pumping costs. Table 6 lists the pumping costs per acre inch at various levels of feet lift and different prices of natural gas, diesel, electricity, and propane.

Table 6. *Energy Pumping Cost Per Acre Inch* [a]

	Total Feet Lift						
	100	200	300	400	500	600	700
Natural Gas ($/mcf)							
$4.00	$1.40	$2.22	$3.04	$3.87	$4.69	$5.52	$6.34
$6.00	2.09	3.33	4.56	5.80	7.04	8.27	9.51
$8.00	2.79	4.44	6.09	7.73	9.38	11.03	12.68
$10.00	3.49	5.55	7.61	9.67	11.73	13.79	15.85
$12.00	4.19	6.66	9.13	11.60	14.07	16.55	19.02
Diesel ($/gal)							
$1.00	1.72	2.74	3.76	4.77	5.79	6.81	7.82
$2.00	3.44	5.48	7.51	9.54	11.58	13.61	15.65
$3.00	5.16	8.22	11.27	14.32	17.37	20.42	23.47
$4.00	6.89	10.95	15.02	19.09	23.16	27.22	31.29
$5.00	8.61	13.69	18.78	23.86	28.95	34.03	39.11
Electricity ($/KWH)							
$0.06	1.46	2.32	3.18	4.04	4.91	5.77	6.63
$0.08	1.95	3.09	4.24	5.39	6.54	7.69	8.84
$0.10	2.43	3.87	5.30	6.74	8.18	9.61	11.05
$0.12	2.92	4.64	6.37	8.09	9.81	11.54	13.26
$0.14	3.40	5.42	7.43	9.44	11.45	13.46	15.47
Propane ($/gal)							
$0.50	1.56	2.48	3.41	4.33	5.25	6.17	7.10
$0.80	2.50	3.97	5.45	6.93	8.40	9.88	11.35
$1.10	3.44	5.47	7.49	9.52	11.55	13.58	15.61
$1.40	4.37	6.96	9.54	12.12	14.70	17.29	19.87
$1.70	5.31	8.45	11.58	14.72	17.85	20.99	24.13

[a] *The basis for fuel calculation is 90 percent of Nebraska Pumping Plant Criteria efficiency ratings. Pressure is assumed to be 30 PSI at the pump outlet.*

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