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 Requirements 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			
Land	XXXXX	$819.00	$ 752.00	_____	_____
Well	$17,185	111.00	137.00	_____	_____
Pump & Gearhead	30,000	194.00	240.00	_____	_____
Power Unit — Natural Gas (Flood)	5,225	34.00	XXX	_____	_____
Power Unit — Natural Gas (Pivot)	6,135	XXX	49.00	_____	_____
Water Meter	1,000	6.00	8.00	_____	_____
Connectors	750	5.00	6.00	_____	_____
Total per Irrigated Acre		$ 1,169.00	$ 1,192.00	_____	_____

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					
System Base Price	1,320		$38,000		_____
Drops on 60" Spacing					_____
Low Drift Nozzles					_____
38" x 11.2 Tires			_____		_____
Sprinkler System Total				$38,000	_____
8" Underground Pipe	1,320	$ 2.58	3,406		_____
Electrical Wiring	1,320	$ 2.31	3,049		_____
Connectors			1,500		_____
10 KVA Generator			2,375		_____
Total Pipe, Electrical, etc.				$10,330	_____
Total Cost of CP System				$ 48,330	_____
System Costs Per Irrigated Acre				$ 387	_____

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

Item	Feet	Price/ft	Costs	Total	Your Farm Total
Gated Pipe[a]	2,640	$ 1.30	$ 3,432		_____
Surge Valve			1,675		_____
Connectors			150		_____
Total Cost of Flood System			_____	$ 5,257	_____
System Costs Per Irrigated Acre				$ 34	_____

[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
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 Values	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				$813 /ac	

[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 4 irrigation zones to cover the 155 acre field. Cost estimates are based on survey data from October 2000.
[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. 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 SDI 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 irrigated acres covered needs to be considered.

Table 5. *Capital Requirements by Irrigation System*

Acres = = >	125		155		155	
Item	Center Pivot		Flood		Drip System	
	/Ac.	/Qtr.	/Ac.	/Qtr.	/Ac.	/Qtr.
Land	$752	$94,000	$819	$126,945	$819	$126,945
Well	137	17,185	111	17,185	111	17,185
Pump & Gearhead	240	30,000	194	30,000	194	23,310
Power Unit	49	6,135	34	6,135	34	6,135
Water Meter	8	1,000	6	1,000	6	1,000
At Well Connectors	6	750	5	750	5	750
System	387	48,330	34	5,257	813	125,952
Total per Irrigated Acre	$1,579		$1,203		$1,982	
Pivot Corner Adjustment [a]		15,330				
Total per 155 Acres		$212,730		$187,272		$307,967
Total per Acre	$1,372		$1,208		$1,987	

[a] Adjustment is for value of nonirrigated corners associated with center pivot systems (30 acres x $511 per acre).

Pumping Costs

Energy source, price, and Total Dynamic Head (TDH) are the major 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*[a]

	Total Dynamic Head (TDH)[b]						
	100	200	300	400	500	600	700
Natural Gas ($/mcf)							
$2.00	$0.37	$0.74	$1.11	$1.48	$1.85	$2.22	$2.60
$3.00	0.56	1.11	1.67	2.22	2.78	3.34	3.89
$4.00	0.74	1.48	2.22	2.97	3.71	4.45	5.19
$5.00	0.93	1.85	2.78	3.71	4.64	5.56	6.49
$6.00	1.11	2.22	3.34	4.45	5.56	6.67	7.79
Diesel ($/gal)							
$0.50	0.46	0.92	1.37	1.83	2.29	2.75	3.20
$0.75	0.69	1.37	2.06	2.75	3.43	4.12	4.80
$1.00	0.92	1.83	2.75	3.66	4.58	5.49	6.41
$1.25	1.14	2.29	3.43	4.58	5.72	6.86	8.01
$1.50	1.37	2.75	4.12	5.49	6.86	8.24	9.61
Electricity ($/KWH)							
$0.04	0.52	1.03	1.55	2.07	2.59	3.10	3.62
$0.06	0.78	1.55	2.33	3.10	3.88	4.65	5.43
$0.08	1.03	2.07	3.10	4.14	5.17	6.20	7.24
$0.10	1.29	2.59	3.88	5.17	6.46	7.76	9.05
$0.10	1.55	3.10	4.65	6.20	7.76	9.31	10.86
Propane ($/gal)							
$0.40	0.66	1.33	1.99	2.66	3.32	3.98	4.65
$0.65	1.08	2.16	3.24	4.32	5.40	6.48	7.55
$0.90	1.49	2.99	4.48	5.98	7.47	8.97	10.46
$1.15	1.91	3.82	5.73	7.64	9.55	11.46	13.37
$1.40	2.32	4.65	6.97	9.30	11.62	13.95	16.27

[a] The basis for fuel calculation is 100% of Nebraska Pumping Plant Criteria efficiency ratings. Irrigation pumps are assumed to be 75% efficient.

[b] TDH = Feet lift + (2.31 × PSI) + Friction Losses.

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