ANNUALIZED COST OF AN IRRIGATION SYSTEM

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WHY COMPUTE THE ANNUALIZED COSTS?

A number of management decisions are based on the annualized costs of owning and operating an irrigation system. Before developing land for irrigation the first decision should be whether the irrigation system will be economically feasible, (will the returns more than offset the costs?). After deciding to proceed with irrigation development, one is faced with many alternative design choices. Sometimes there are offsetting costs and benefits associated with choices; e.g. lower initial cost for one distribution system vs. another may result in higher labor costs and/or lower irrigation efficiency which may increase operating cost and partially or completely offset the initial savings. Aside from development and design considerations, on rented land, an estimate of ownership and operating costs is necessary when negotiating a fair rental arrangement between the landowner and tenant.

Economic Feasibility Studies

Following a dry year like 2000, there is increased interest in developing irrigation. The question is: Will the return in higher yields over the life of the system more than off-set the cost of ownership and operation plus the additional crop input expenses for irrigated vs. dryland production? The only way to truly answer this question is to do a thorough economic feasibility analysis.

Irrigation systems have many components, each of which has a different expected useful life, anticipated repair costs, and different estimates for labor for normal operation and maintenance. Component costs, service life, maintenance repair, and energy costs all can differ under the same operating conditions depending on the design choices made.

If one has a set of financial records and has been irrigating in the past, they may have a pretty fair estimate of the expected out-of-pocket costs for operation and maintenance for an irrigation system. Out-of-pocket expenses only account for a portion of the total costs, however. When conducting an economic feasibility

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study, one must consider both the costs associated with ownership and the cost of operation.

Comparing Choices

The annualized cost of an irrigation system is dependent on the design choices made. Different systems have different costs. For example: A center pivot sprinkler system will likely have a higher initial cost and a higher cost per inch of water delivered than a gated pipe system (because of higher system pressure) but probably will require less gross water applied to meet crop needs and fewer hours of labor for operation. The question is, will the savings offset the higher costs over the life of the system?

The energy required for irrigation pumping is dependent on both the quantity pumped (acre-inches) and the total head (lift plus pressure) the pump is working against. In a given situation, the lift component of the head cannot be changed but the pressure required does change from one type of system to another, resulting in different fuel costs per acre-inch delivered.

There are four energy sources typically used for pumping irrigation water. They are: Diesel, Electricity, Natural Gas, and Liquid Propane (LP) gas. Different energy sources can be expected to deliver a different number of horsepower hours of useful work per unit of energy consumed and per dollar spent on energy. When fuel prices change relative to one another, the most economical energy source can change. The energy source selected dictates the type of power unit that must be purchased as well. Different types of power units have greatly different purchase prices and estimated useful service lives.

Crop Share Rental Arrangements

Occasionally, extension staff are asked to help landowners and tenants work out fair crop share rental arrangements. One method used in extension is to sit down with both parties and develop a listing of the monetary value of the contributions each party is making. The landowner needs to receive a fair return on the value of his land and other assets as well as cover his costs for taxes, upkeep and insurance. The tenant needs to receive a fair return on his labor and machinery and cover his variable expenses such as fuel and repairs. Some or all, crop input expenses may be shared in most crop-share arrangements, but how they are shared varies case by case.

When computing a fair crop-share rental arrangement, the procedure is to list all the contributions that are required for crop production in a table (land, irrigation system, machinery, labor, crop inputs, etc.). After each input listed, the contribution each party is making is shown in parallel columns; one for the landowner and one for the tenant. The columns are tallied and the percentage of the total cost that each party is making is calculated. The "fair" rental arrangement would be to divide the crop on the same percentage as the contributions that each party has made. Alternately, after the initial listing is

done, changes are sometimes made in the percentage the two parties contribute to certain inputs until contributions match a pre-determined crop share arrangement (e.g. 60/40 or 50/50).

The costs of owning and operating the irrigation system are some of the most difficult to identify when analyzing irrigated crop share arrangements. Much of the total cost of irrigation results from ownership costs and a large percentage of ownership costs are not annual out-of-pocket costs.

A complicating factor in some rental agreements results from who owns the various components. In some cases, the landowner may furnish the entire irrigation system; in other cases the landowner may furnish the well, pump and gear head; while the tenant may furnish the power unit and/or the distribution system. A need therefore exists for the analyst to easily estimate the ownership and operating costs for each major component in various irrigation systems so each party is credited with a fair estimate of the contribution he/she is making.

Examples

The author has developed a computerized spreadsheet which can assist the manager with analyzing the costs described in this paper. Since a picture is worth a thousand words, following are some sample runs. Figures 1 and 2 represent a typical center pivot system in central Nebraska. The difference between these are the energy sources used (diesel vs. natural gas). Figures 3 and 4 both use an electric motor to pump the water, the difference is the distribution system used (center pivot vs. gate pipe with a surge valve). Many other comparisons like these could be made, so long as the prices for the alternative components and energy sources are known.

Summary

As can be seen, this approach can be used to determine the annualized costs when conducting an irrigation economic feasibility study. One can compare the ownership and operating costs for an array of possible irrigation design choices, the result being identification of the most economically feasible choice for a given situation. Finally, it also can be used to help put a value on the assets, labor, expected fuel costs, etc. when analyzing rental arrangements.

This spreadsheet was developed in Corel Quattro Pro v.9 for Windows $_{TM}$. It has been converted using the conversion utility to Microsoft Excel$_{TM}$ v5/v7 format. Interested parties can download these spreadsheets at no cost from the following website: http://www.ianr.unl.edu/ianr/lanco/ag/crops/irrigate.htm . Click on the heading Annualized Cost of an Irrigation System and then right click on the format you want to download. Use the "save link as" feature to save the file to a folder (directory) on your computer. You should then be able to open your spreadsheet program, browse to the file, and open it.

Annualized Cost of an Irrigation System

Figure 1 - Diesel & Pivot

Distribution System Code	**1**	**Distribution System Codes**	**Fuel Source Codes**
Acres Irrigated	**130**	Center Pivot = 1	Diesel = 1
Pumping water level, ft.	**125**	Gated Pipe = 2	Nat Gas = 2
System Pressure, PSI	**35**	Surge Valve = 3	LP Gas = 3
Gross Depth applied, inches	**12**	Siphon Tube = 4	Electricity = 4
Fuel Source Code	**1**	Drip System=5	**$0.00**
$/Gal Diesel	**$1.000**		
Labor Chrg, $/hour	**$10.00**		
Irrigation District, $/ac-ft	**0**		
Return on Invest. (R.O.I), %	**5**		
Drip Oil, $/gal	**$6.00**		

Component				**Ownership Costs**			**Operating Costs**			
	Initial Cost	**Life**	**Salvage[1]**	**R.O.I.**	**Insurance + tax**	**Depr**	**Repairs[2]**	**Oper. labor**	**Energy[3]**	**Total**
Irrigation Well	**$12,543**	25	-$627	$316	$125	$527	$163	$16		$1,147
Irrigation Pump	**$10,148**	18	$507	$228	$101	$536	$355	$62		$1,282
Gear Head	**$1,900**	15	$95	$42	$19	$120	$25	$16		$222
Pump Base, etc.	**$1,433**	25	$72	$33	$14	$54	$22	$16		$139
Diesel Engine & Tank	**$11,571**	12	$579	$252	$231	$916	$507	$234	$2,919	$5,060
Center Pivot System	**$33,000**	15	$1,650	$732	$660	$2,090	$1,287	$468	$291	$5,528
	$0	25	$0	$0	$0	$0	$0	$0	$0	$0
										$0
Totals	$70,595		$2,275	$1,602	$1,152	$4,243	$2,359	$811	$3,211	$13,378

	Ownership Costs	**Operating Costs**	**Costs**
Total annual cost	$6,996.79	$6,380.90	$13,377.69
Annual $/ Acre	$53.82	$49.08	$102.91
$/ac-in	$4.49	$4.09	$8.58

[1] End of life salvage value 5% of purchase price except for irrigation well. End of life cost for well = 5% to plug the well
[2] Drip oil added to repair costs. For internal combustion engines, 5% of energy costs added to repair costs for oil, filters, and lube.
[3] Energy Cost assumes operating at 100% of the NPC. Hookup charge added for Electric Units.

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Annualized Cost of an Irrigation System

Figure 2 - LP gas & Pivot

Distribution System Code	1	**Distribution System Codes**	**Fuel Source Codes**
Acres Irrigated	130	Center Pivot = 1	Diesel = 1
Pumping water level, ft.	125	Gated Pipe = 2	Nat Gas = 2
System Pressure, PSI	35	Surge Valve = 3	LP Gas = 3
Gross Depth applied, inches	12	Siphon Tube = 4	Electricity = 4
Fuel Source Code	3	Drip System=5	**$0.00**
$/Gal LP Gas	$0.850		
Labor Chrg, $/hour	$10.00		
Irrigation District, $/ac-ft	0		
Return on Invest. (R.O.I), %	5		
Drip Oil, $/gal	$8.00		

Component				**Ownership Costs**			**Operating Costs**			
	Initial Cost	**Life**	**Salvage[1]**	**R.O.I.**	**Insurance + tax**	**Depr**	**Repairs[2]**	**Oper. labor**	**Energy[3]**	**Total**
Irrigation Well	$12,543	25	-$627	$316	$125	$527	$163	$16		$1,147
Irrigation Pump	$10,148	18	$507	$228	$101	$536	$403	$62		$1,330
Gear Head	$1,900	15	$95	$42	$19	$120	$25	$16		$222
Pump Base, etc.	$1,433	25	$72	$33	$14	$54	$22	$16		$139
LP Gas Engine	$4,395	6	$220	$87	$88	$696	$362	$234	$4,502	$5,969
Center Pivot System	$33,000	15	$1,650	$732	$660	$2,090	$1,287	$468	$449	$5,686
	$0	25	$0	$0	$0	$0	$0	$0	$0	$0
										$0
Totals	$63,419		$1,917	$1,437	$1,008	$4,023	$2,262	$811	$4,951	$14,493

	Ownership Costs	**Operating Costs**	**Costs**
Total annual cost	$6,468.18	$8,024.53	$14,492.71
Annual $/ Acre	$49.76	$61.73	$111.48
$/ac-in	$4.15	$5.14	$9.29

[1] End of life salvage value 5% of purchase price except for irrigation well. End of life cost for well = 5% to plug the well
[2] Drip oil added to repair costs. For internal combustion engines, 5% of energy costs added to repair costs for oil, filters, and lube.
[3] Energy Cost assumes operating at 100% of the NPC. Hookup charge added for Electric Units.

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Annualized Cost of an Irrigation System

Figure 3 - Electric & Pivot

Distribution System Code	**1**	**Distribution System Codes**	**Fuel Source Codes**
Acres Irrigated	**130**	Center Pivot = 1	Diesel = 1
Pumping water level, ft.	**125**	Gated Pipe = 2	Nat Gas = 2
System Pressure, PSI	**35**	Surge Valve = 3	LP Gas = 3
Gross Depth applied, inches	**12**	Siphon Tube = 4	Electricity = 4
Fuel Source Code	**4**	Drip System=5	**Annual Electric Hookup Charge** **$1,650.00**
$/kW.h Elec	**$0.040**		
Labor Chrg, $/hour	**$10.00**		
Irrigation District, $/ac-ft	**0**		
Return on Invest. (R.O.I), %	**5**		
Drip Oil, $/gal	**$8.00**		

Component	**Initial Cost**	**Life**	**Salvage[1]**	**Ownership Costs**			**Operating Costs**			**Total**
				R.O.I.	**Insurance + tax**	**Depr**	**Repairs[2]**	**Oper. labor**	**Energy[3]**	
Irrigation Well	**$12,543**	25	-$627	$316	$125	$527	$163	$16		$1,147
Irrigation Pump	**$10,148**	18	$507	$228	$101	$536	$403	$62		$1,330
Gear Head	**$0**	15	$0	$0	$0	$0	$0	$0		$0
Pump Base, etc.	**$1,433**	25	$72	$33	$14	$54	$22	$16		$139
Electric Motor& Switches	**$2,900**	20	$145	$65	$58	$138	$255	$39	$3,299	$3,855
Center Pivot System	**$33,000**	15	$1,650	$732	$660	$2,090	$1,287	$468	$165	$5,401
	$0	25	$0	$0	$0	$0	$0	$0	$0	$0
										$0
Totals	$60,024		$1,747	$1,373	$959	$3,345	$2,131	$601	$3,464	$11,873

	Ownership Costs	**Operating Costs**	**Costs**
Total annual cost	$5,677.15	$6,195.40	$11,872.55
Annual $/ Acre	$43.67	$47.66	$91.33
$/ac-in	$3.64	$3.97	$7.61

[1] End of life salvage value 5% of purchase price except for irrigation well. End of life cost for well = 5% to plug the well

[2] Drip oil added to repair costs. For internal combustion engines, 5% of energy costs added to repair costs for oil, filters, and lube.

[3] Energy Cost assumes operating at 100% of the NPC. Hookup charge added for Electric Units.

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Annualized Cost of an Irrigation System

Figure 4 - Electric & Gated Pipe

Distribution System Code	2	**Distribution System Codes**	**Fuel Source Codes**
Acres Irrigated	150	Center Pivot = 1	Diesel = 1
Pumping water level, ft.	125	Gated Pipe = 2	Nat Gas = 2
System Pressure, PSI	10	Surge Valve = 3	LP Gas = 3
Gross Depth applied, inches	15	Siphon Tube = 4	Electricity = 4
Fuel Source Code	4	Drip System=5	**Annual Electric Hookup Charge** **$1,980.00**
$/kW.h Elec	$0.040		
Labor Chrg, $/hour	$10.00		
Irrigation District, $/ac-ft	0		
Return on Invest. (R.O.I), %	5		
Drip Oil, $/gal	$8.00		

Component				Ownership Costs			Operating Costs			
	Initial Cost	Life	Salvage[1]	R.O.I.	Insurance + tax	Depr	Repairs[2]	Oper. labor	Energy[3]	Total
Irrigation Well	$12,543	25	-$627	$316	$125	$527	$235	$23		$1,226
Irrigation Pump	$10,148	18	$507	$228	$101	$536	$581	$90		$1,536
Gear Head	$0	15	$0	$0	$0	$0	$0	$0		$0
Pump Base, etc.	$1,433	25	$72	$33	$14	$54	$32	$23		$156
Electric Motor& Switches	$4,761	20	$238	$107	$95	$226	$399	$56	$3,691	$4,575
Gate Pipe	$8,745	15	$437	$194	$87	$554	$394	$1,125	$0	$2,354
Reuse?	$10,225	25	$511	$233	$205	$389	$575	$450	$100	$1,951
										$0
Totals	$47,855		$1,138	$1,111	$628	$2,285	$2,216	$1,766	$3,791	$11,798

	Ownership Costs	Operating Costs	Costs
Total annual cost	$4,024.59	$7,773.63	$11,798.22
Annual $/ Acre	$26.83	$51.82	$78.65
$/ac-in	$1.79	$3.45	$5.24

[1] End of life salvage value 5% of purchase price except for irrigation well. End of life cost for well = 5% to plug the well

[2] Drip oil added to repair costs. For internal combustion engines, 5% of energy costs added to repair costs for oil, filters, and lube.

[3] Energy Cost assumes operating at 100% of the NPC. Hookup charge added for Electric Units.

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