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SOME ECONOMIC COMPARISONS OF DIFFERENT IRRIGATION SYSTEMS

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Some Economic Comparisons of Different Irrigation Systems[1/]

-by-

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New developments in irrigation have multiplied the alternatives open to a prospective irrigator and thereby increased the complexity of decision-making in the irrigation area.

Presumably each prospective irrigator is interested in securing a system which will fit his particular needs and at the same time enable him to make as much money as possible from his irrigated production. Growing concern over the conservation of underground water resources, apart from costs, may be a factor in his thinking also.

Circumstances on a particular farm may dicatate that only certain systems be considered. Sandy soils may essentially prevent consideration of any type of gravity irrigation. The scarcity of capital may just as effectively eliminate the consideration of other systems, but this gets us into economic comparisons, the main point of this particular discussion.

No single set of figures can possibly represent all of the situations which might be of interest. Consequently, anyone interested in the economics of the various systems as they might apply to his particular circumstances, should do some pencil pushing of his own. Nevertheless, a comparison of different systems with a particular set of circumstances does serve to illustrate some of the differences in investments and costs which tend to be involved.

For purposes of this presentation, it was assumed that 15 inches of

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effective water would be needed. There is an 1100 gallon well with a 100 foot lift. The pump was set at 150 foot. A propane engine was used in calculating the cost of all systems. In the reuse system, the power for the reuse system was assumed to be a 5 horse single phase electric motor. Costs were also figured for two of the systems using diesel engines.

Capital Requirements

Table 1 shows the capital requirements for the systems being compared with and without an allowance for leveling. From the standpoint of the amount of capital required, there would be considerable advantage to the gravity systems, espeically if the land requires comparatively little leveling for satisfactory gravity irrigation. On the other hand, if as much as $70 an acre is required to make a gravity distribution system workable, (as used in Table 1) then the total amount of capital required including the amount spent for leveling may be little different than for one of the sprinkler systems. It should be noted that $1500 was included in the amount of capital for the sprinkler systems on the basis that some leveling is desirable for drainage reasons.

It should be noted, too, that the actual number of acres which can be irrigated differs between systems. In this example, we have assumed that there is a quarter of land available. According to our engineers, an 1100 gallon well using gravity without either a reuse or cutback system would be capable of irrigating only about 100 acres in an adequate fashion simply because of the amount of water available and the low level of efficiency in the use of water. Both the tow-line system and the water winch would require some area for movement of the irrigation equipment. The center pivot system would leave the corners unirrigated. Hence the number of acres which

Table 1. Comparative Investments

	Gated Pipe							
	no reuse or Cutback	With reuse system	With cutback system	Tow-line sprinkler	Water Winch		Center Pivot	
					Dryer	Propane	Diesel	Propane
Well	$ 2,200	$ 2,200	$ 2,200	$ 2,200	$ 2,200	$ 2,200	$ 2,200	$ 2,200
Pump & gearhead	3,115	3,275[a/]	3,115	4,100	4,780	4,780	4,550	4,550
Engine	1,226	1,946[a/]	1,226	1,900	4,785	2,365	4,360	2,100
Fuel tanks	250	250	250	250	250	500	250	500
Distribution	8,250	8,804[a/]	8,250	12,710	12,750	12,750	17,500	17,500
Total	$15,041	$16,475[a/]	$15,041	$21,160	$24,765	$22,595	$28,860	$26,850
Per acre	150	110	107	151	177	161	214	199
Leveling	7,000	10,500	9,800	1,500	1,500	1,500	1,400	1,400
Total	$22,041	$26,975[a/]	$24,841	$22,660	$26,265	$24,095	$30,260	$28,350
Per acre	220	180	177	162	188	172	224	210
Acres irrigated	100	150	140	140	140	140	135	135

a/Includes reuse equipment.

would actually be irrigated from a well of a given size would vary according to the system.

Operating Costs

In figuring the fixed costs, the life expectancies shown in Extension Circular EC 64-733, "Pump Irrigation: Cost Analysis" were used. Interest was figured at 8 percent. Propane fuel was figured at 12 cents a gallon and diesel at 16 cents. Labor requirements were based on information in Extension Circular EC 65-753 and information obtained from Paul Fischbach.

Table 2 shows how these costs compare. It is significant that the gated pipe system without either reuse or cutback is not capable of adequately handling more than 100 acres. This results in high fixed costs per acre irrigated--almost as high as for the center pivot system. The actual amount of fixed costs depends considerably on the amount of leveling needed. It is the most extravagant user of water of any system in the comparison.

The system using gated pipe and a reuse system is the only one which permits irrigation of all of the cropland in a quarter section. This system has the highest water use efficiency of any of the systems shown. As a result, the operating costs are spread over more acres (50 percent more than where no reuse system is used or no cutback is made) and are the lowest per acre irrigated of any of the sytems. Fixed costs are also moderately low. Labor requirements on a per acre basis are the same as where no reuse system is involved.

Gated pipe where a cutback system is used does not make quite as efficient use of water as where a reuse system is used. As a consequence, the water supply can serve only 140 acres adequately. Total costs of irrigation are higher per acre irrigated than the reuse system but lower than where neither reuse or cutback is used. Labor requirements, according to the

Table 2. Costs of Operating Different Systems When 15" of Effective Water Applied.

Item	Gated Pipe			Tow-line sprinkler	Water Winch		Center Pivot	
	No reuse or cutback	With reuse	With cutback		Diesel fuel	Propane fuel	Diesel fuel	Propane fuel
Variable costs								
Fuel	$ 610	$ 645	$ 680	$1,315	$1,593	$1,897	$1,298	$1,545
Electricity		94			198	198		
Oil	53	55	59	113	183	163	149	133
Repairs	56	59	62	121	272	174	222	142
Labor on system	82	87	92	99	99	99	89	89
Total	$ 801	$ 940	$ 893	$1,648	$2,345	$2,531	$1,758	$1,909
Irrigation labor	200	300	840	280	280	280	88	88
Total	$1,001	$1,240	$1,733	$1,928	$2,625	$2,811	$1,846	$1,997
Fixed costs	$2,310	$2,803	$2,562	$2,541	$3,055	$2,698	$3,499	$3,191
Total	$3,311	$4,043	$4,295	$4,469	$5,680	$5,509	$5,345	$5,188
Acres irrigated	100	150	140	140	140	140	135	135
Per acre costs								
Variable	10.01	8.27	12.38	13.77	18.75	20.08	13.67	14.79
Fixed	23.10	18.69	18.30	18.15	21.82	19.27	25.92	23.64
Total	33.11	26.96	30.68	31.92	40.57	39.35	39.59	38.43
Efficiency in percent	60	85	75	75	75	75	75	75

engineers, are 3 times as high per acre irrigated as either of the other two. This comparatively high labor requirement would be particularly disadvantageous on farms where labor is in extremely short supply.

With the tow-line system, variable operating costs exclusive of labor are nearly twice as high as for the gravity systems. Fixed costs are about the same as the gravity systems using either a reuse system or cutback when the gravity systems include taxes and interest on a $70 leveling investment. A larger investment in distribution equipment substituted for the higher leveling cost of gravity systems. On a per acre basis, the labor requirement used is about the same as for the gravity-reuse system.

The water winch apparently is a system designed for use on 40 to 80 acres. For purposes of our comparison, it was assumed that one winch could be used on 80 acres but that one well could serve two winch outfits. This results in a comparatively large investment in distribution equipment. The high pressure required by the system (75-85 lbs.) coupled with friction losses make for high power requirements--the highest of any of the systems here compared. Labor requirements were estimated to be similar to those for the tow-line system. Total costs per acre irrigated with either propane or diesel fuel were nearly a third higher than for the tow-line system.

The center pivot system is unique in terms of the amount of labor required. Labor requirements, as used here, are only about a third as high on a per acre basis as any of the other systems except the gated pipe with a cutback. Labor requirements for the latter are estimated to be nine times as high as for the center pivot system. Variable operating costs other than labor are comparable to those for the tow-line--possibly just a bit higher. The high cost of the distribution system itself makes fixed costs high,

however--the highest of any of the systems compared on the basis of an irrigated acre. Total costs of irrigation are very comparable with costs of the water winch.

A study of different irrigation systems on North Dakota farms shows somewhat different labor requirements than those used here. Had these figures been used, the tow-line would have had a total labor requirement 4 to 5 times as high as used here. With labor valued at $2 an hour, this would have increased the total cost of irrigation to $39.12 an acre instead of the $31.92 shown here. With the assumption that labor requirements for the water winch would be comparable to those for the tow-line, costs for the water winch system also would have been increased about $7 an acre. In the North Dakota study, labor requirements for gated pipe were a little more than twice as high as those used here. Those for the center pivot systems were actually lower, however.

No attempt has been made here to assess the economic consequences of the differences in acreages which could be irrigated. This is an important variable which should not be overlooked in a more exhaustive comparison.