IRRIGATION SYSTEM ECONOMICS AS AFFECTED BY FIELD SIZE

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INTRODUCTION

Sprinkler irrigation systems have an economic advantage over subsurface drip irrigation (SDI) systems for fields where full size center pivots can be utilized. In these scenarios, center pivots gain important cost economies from spreading system investment costs over the maximum number of acres.

This paper considers a number of factors that affect the relative profitability of the irrigation systems. First, how are the cost economy advantages of center pivot systems over SDI systems affected as field size decreases and field shapes change? Important factors to consider are a) variation in irrigation system investment cost economies by field size and shape (i.e, the capital or fixed cost effects), b) potential differences in crop revenue for cropping systems that fully utilize all acres in irrigated crop enterprises as opposed to those that must include nonirrigated production, and c) differences in water application efficiencies for center pivot and SDI systems (i.e., the variable or operating cost effects).

This analysis is the assumes that a field is currently being flood irrigated, but is to be transformed into either a center pivot or SDI irrigation system. It is also assumed that the existing well is centrally located at the edge of the field, is fully depreciated out, but not yet in need of replacement. From this starting point, cost estimates for alternative irrigation systems together with Extension crop enterprise budgets for irrigated corn and summer fallow wheat in western Kansas will be used to project annual profitability for the alternative irrigation and cropping systems. An objective of this paper is to compare center pivot and SDI system costs per acre as field sizes and shapes change.

FACTORS AFFECTING THE CHOICE OF IRRIGATION SYSTEM

Center pivot irrigation systems have a cost advantage over SDI systems on large land tracts (i.e. 1/4 sections) where per acre investment costs can be lowered by spreading them out over a large number of acres. However, center pivot investment costs tend to be "chunky" or "sticky" as acreage decreases for less than 125 acre center pivots or for irregularly shaped fields. Some "sticky" center pivot cost factors may include the following items: the pivot pad, the underground pipe from the well to the pivot system, installation labor, generator and electric wiring, etc.

The expected life of an irrigation system is another concern. The center pivot is assumed to have a 20 year life, with a range of from 15 to 25 years. The SDI system is assumed to have a 10 year life, with a range of from 5 to 15 years. Life of the system has a major impact on profitability as the initial investment cost per acre is amortized out over the expected life of the system. This is especially critical for SDI systems, where uncertainty about expected system life can dramatically impact the costs a farmer is willing to assume in budget projections.

The replacement cost or salvage value of each system is another major consideration in this analysis. In these budgets, both systems are assumed to have 0% salvage value. This is a common assumption and practice in western Kansas. However, in some cases center pivots will have some salvage value after 20 years. For this analysis, it is assumed that at the end of 10 years, the full current cost of an SDI system will be incurred to renovate the old system, without consideration of inflation costs, etc.. More information is needed regarding the projected costs of renovateing, repairing, and/or replacing an existing SDI system with a new SDI system in the future.

Irrigation water application efficiency may effect the choice of irrigation system. In this study, it is assumed that SDI water applications are 10% more efficient than center pivot applications. Center pivot systems are assumed to apply 18 inches of water while SDI systems are assumed to apply 16 inches. Because of reduced water application, SDI systems will have lower fuel, oil, and electricity costs, and marginally lower repair and operating interest costs than center pivot systems.

There will also be revenue differences among center pivot and SDI-oriented cropping systems. The primary factor affecting relative profitability will be lower revenue produced from nonirrigated farmland in center pivot corners as compared to higher revenue on these same acres in SDI systems. A major issue for farmers considering center pivot versus SDI will be which cropping system produces the highest net revenue across all acres - including both dryland and irrigated crop enterprises.

A number of other factors are not accounted for in this analysis. Lower production and income risk for the irrigated as opposed to nonirrigated cropland in the center pivot system is not studied here, but is a factor that would be expected to favor the 100% acreage coverage available with SDI systems. There are potential irrigation water application uniformity benefits for SDI as opposed to center pivot irrigation systems which are not dealt with here. Also, with declining water tables in some local areas of western Kansas, and therefore limited irrigation time horizons, the increased efficiency of SDI systems could potentially reduce the rate of water use, lengthen the life of the local aquifer, and better match the expected investment time horizon of the irrigated enterprise in areas where declines are most precipitous.

In summary, fixed or capital costs per acre will be affected by initial irrigation system costs as well as the expected life of the system and the cost to renovate it (especially for SDI systems). Variable operating costs per acre will be affected by the irrigation water application efficiencies of each system. Cropping system gross and net revenues will be affected by the number of nonirrigated acres necessary in center pivot cropping systems relative to fully irrigated SDI cropping systems.

ANALYSIS

Framework Used for Analyzing Irrigation System Economics

An enterprise budget framework is used to analyze the profitability of the alternative irrigation system investments for each field size scenario. Projected crop production system net returns to land and management are calculated as follows.

First, gross revenue is projected for each field size scenario for both a center pivot-oriented cropping system (with a combination of irrigated corn and non-irrigated summer fallow wheat acreage) and an SDI-oriented cropping system (with 100% irrigated corn acreage). Differences in crop returns will show the effect upon total and net revenue per acre of combined irrigated / dryland cropping systems for center pivots and irrigated acres-only cropping systems for SDI. Then, variable costs of production for the

Table 2, Subsurface Drip Irrigation System Capital Requirements for Alternative Field Sizes

Item	$/Unit	Subsurface Drip Irrigation System Scenarios					
		Base (O)	A	B	C	D	E
Number of SDI Acres		160 acres	127 acres	95 acres	64 acres	32 acres	80 acres
8” Mainline pipe	$1.30/ft	$6,006	$2,293	$1,763	$1,086	$761	
6” Lateral / submain pipe	$0.75/ft	1,020	3,528	3,051	1,253	439	$3,565
4” Flushlines	$0.60/ft	7,104	5,645	3,661	2,004	1,416	3,168
Drip tape	$0.03/ft	41,976	33,193	24,829	16,733	8,354	20,909
Drip tape connectors	$0.75/ft	3,168	2,820	1,829	1,002	708	1,584
8x8x8x8 Cross	$200/cross	400					
8x8x6x6 Cross	$200/cross		200				
8x8x8 T	$340/T						
8x6 Reducing coupling	$25/coupling	100	25		25	25	
8x8x6 T	$340/T			340			
8” Pressure control valve	$440/valve	1760				440	
6x6x6 T	$145/T		145	145	145		435
6” Endcaps	$45/cap		180	270	90	45	180
6” Valves	$375/valve		1,500	1,125			
6” Elbows	$95/elbow			95			190
6”x 4” Reducing couplings	$20/cplg	80					
4” Elbows	$30/elbow	360	480	300	240	120	480
4” Valves	$375/valve						1,500
4” x 2” Reducing bushing	$18/bushng	216	288	180	144	72	288
2” Plugs	$6/plug	72	96	60	48	24	96
Air vents	$25/vent	350	350	350	350	150	350
PVC glue		250	250	200	200	200	250
Trenching	$0.68/ft	10,322	9,196	6,455	3,975	2,400	5,384
Filter		4,500	4,500	4,500	4,500	4,500	2,200
Pressure gauges	$20/gauge	360	360	280	280	140	360
Producer labor (installation)	$8/labor hr	7,200	6,376	4,360	2,384	1,240	3,792
Tractor use (installation)	$7/tractor hr	966	833	595	378	217	525
Total Costs		$86,210	$72,258	$54,388	$34,836	$21,251	$45,606
System Costs / Irrigated Acre		$539 /acre	$569 /acre	$573 /acre	$544 /acre	$664 /acre	$570 /acre

In Table 2, the results in the last row for Total Cost Per Acre do not indicate the same degree of diminishing cost economies (i.e., higher capital cost per acre for smaller fields) in this example for SDI irrigation systems as exists for center pivot systems (see Table 1). Although initial SDI irrigation system costs begin at a higher level than pivot systems for the full 160 acre scenario O ($539 per acre for SDI vs $326 per acre for pivot systems), per acre investment costs do not dramatically change as field size diminishes. Investment cost for an 80 acre SDI system ($570 per acre) are comparable to those for a Wiper pivot system ($532 per acre, Table 1).

The per acre capital requirements for SDI systems in Table 2 imply a higher degree of proportional adjustability to changes in field size than do center pivot irrigation system costs. As field size diminishes in these scenarios, the SDI system costs are more nearly stable on a per acre basis than are those for center pivot irrigation systems.

Crop Enterprise Budget Framework

The differing enterprise acreages, variable costs and fixed costs of each cropping system are examined within the framework of two KSU Farm Management crop enterprise budgets. The net revenue from irrigated acres is estimated using a 190 bushel per acre yield scenario, together with prices and costs for irrigated corn production in western Kansas as represented in the 1996 version of <u>MF-585, Center Pivot Irrigated Corn</u> (Table 3). The net revenue from non-irrigated acres is estimated using the 40 bushel per acre yield scenario from <u>MF-257, Summer Fallow Wheat in Western Kansas</u> (Table 4).

Tables 3 and 4 represent the irrigated corn and dryland wheat cost-return budgets used in scenario O (Full Circle Center Pivot). The only changes for other pivot irrigation scenarios would occur due to different pivot investment costs per acre (lines 21-22 in Table 3). These changes would correspond with the total investment costs per acre indicated in the last column in Table 1. For comparative SDI scenarios, the pivot investment costs would differ from lines 21-22 in Table 3 in accordance with results in the last row of Table 2. An additional change for SDI would occur in the variable cost of irrigation water applied (lines 7, 9, and 15). Note that no opportunity interest costs to land, real estate taxes, or land rental costs are included in these budgets. Also, no management charges are included. Therefore, the net returns calculated represent net returns to both land and management.

Table 3. Irrigated Corn Cost-Returns Budget for Western Kansas (125 Acre Center Pivot)

VARIABLE COSTS	Income/Expense
1. Labor (2.35 hrs/acre × $9.00 /hr)	$21.15
2. Seed (32 lbs/acre × $1.05 /lb)	33.60
3. Herbicide	33.12
4. Insecticide	41.57
5. Fertilizer (Anhydrous: 180 lbs × $0.17 /lb = $30.60)	46.20
(N Dry: 10 lbs × $0.30 /lb = $3.00)	
(Phosphorous: 45 lbs × $0.28 /lb = $12.60)	
6. Fuel and Oil - Crop	10.45
7. Fuel and Oil - Pumping (18 inches water applied × $2.71/inch)	48.78
8. Crop Machinery Repairs & Maintenance	23.20
9. Irrigation Equipment Repairs & Maintenance (18 inches water applied × $0.30/in)	5.40
10. Crop Insurance	6.75
11. Drying ($0.10/bu × 190 bu/acre)	19.00
12. Custom Hire	0.00
13. Crop Consulting	6.50
14. Miscellaneous	7.00
15. Interest on 1/2 Variable Cost (10% operating interest)	15.14
A. Total Variable Costs (Excluding management charges or returns)	$317.85 /ac
FIXED COSTS	
16. Real Estate Taxes (($650/acre land + $290/a well) x 0.5%), but 0% here	$0.00
17. Interest on Land and Well (($650/ac land + $290/a well) x 6%), but 0% here	0.00
18. Rent for Rented Land	0.00
19. Depreciation on Crop Machinery ($236/a investment, 35% salvage value of $83/a, 10 yr straightline depreciation)	15.34
20. Interest on Crop Machinery (10% interest on average machinery value: (($236 + $83) ÷ 2) x 10%)	15.93
21. Depreciation on Irrigation Equipment (Power+Motor = $50/a, 7 yrs, 0% slvg; Irrigation System = $326/a, 20 years, 0% slvg; 0% deprec for Well)	23.46
22. Interest on Irrigation Equipment & Well (10% int. on avg irrig. equip. value: (($50 + $326) ÷ 2) x 10%)	18.81
23. Insurance on Crop & Irrigation Equipment (0.25% x ($236 + $50 + $326))	1.53
B. Total Fixed Costs (Excluding land opportunity interest or rent)	$75.07 /ac
C. TOTAL COSTS (Excluding land and management costs: A + B)	$398.38 /ac
D. Yield	190 bu /ac
E. Price Per Bushel	$2.50 /bu
F. Production Flexibility Contract Payments (Irrigated land in Thomas Co., KS)	$35.00 /ac
G. RETURNS / acre ((D x E) + F)	$510.00 /ac
H. Returns Over Variable Costs / acre (Excluding management cost: G - A)	$192.15 /ac
I. RETURNS OVER TOTAL COSTS / acre (Excluding land and management costs: G - C)	$111.62 /ac

Table 4. Summer Fallow Wheat Cost-Return Budget for Western Kansas

VARIABLE COSTS	Income/Expense
1. Labor (1.2 hrs/acre × $9.00/hr)	$10.80
2. Seed (50 lbs/acre × $0.20/lb)	10.00
3. Herbicide	14.82
4. Insecticide	0.00
5. Fertilizer (Anhydrous: 40 lbs × $0.17/lb = $6.80)	15.20
(Phosphorous: 30 lbs × $0.28 /lb = $8.40)	
6. Fuel and Oil	6.95
7. Crop Machinery Repairs & Maintenance	10.92
8. Crop Insurance	4.89
9. Drying	0.00
10. Custom Hire	0.00
11. Crop Consulting	6.50
12. Miscellaneous	5.00
13. Interest on 1/2 Variable Cost (10% operating interest)	3.93
A. Total Variable Costs (Excluding returns to management)	$82.51 /ac
FIXED COSTS	
14. Real Estate Taxes (($525 /a land ÷ 2 year rotation) × 0.5%), but 0% here	$0.00
15. Interest on Land (($525 /a land ÷ 2 year rotation) × 6%), but 0% here	0.00
16. Rent for Rented Land	0.00
17. Depreciation on Crop Machinery ($190/a investment, 35% salvage value of $67 /a, 10 yr straightline depreciation)	12.35
18. Interest on Crop Machinery (10% interest on average machinery value: (($190 + $67) ÷ 2) × 10%)	12.83
19. Insurance on Crop Machinery (0.25% × $190)	0.48
B. Total Fixed Costs (Excluding land opportunity interest or rent)	$25.65 /ac
C. TOTAL COSTS (Excluding land and management: A + B)	$108.16 /ac
D. Yield	40 bu /ac
E. Price Per Bushel	$3.65 /bu
F. Production Flexibility Contract Payments (Nonirrigated land in Thomas Co., KS)	$10.00 /ac
G. RETURNS / acre ((D x E) + F)	$156.00 /ac
H. Returns Over Variable Costs / acre (Excluding management cost: G - A)	$73.49 /ac
I. RETURNS OVER TOTAL COSTS / acre (Excluding land and management costs: G - C)	$47.84 /ac

RESULTS

Table 5 indicates that pivot-oriented cropping systems have a marked net revenue advantage over SDI cropping systems for large fields, such as for the 160 and 127 acre fields in Scenarios O and A. The net return advantage of the pivot cropping system over the SDI cropping system in scenario O is $22 per acre over the total cropland acreage as indicated in the "Total Returns / Acre (Pivot – SDI)" row in the Net Returns section of Table 5. As total acreage decreases to 127 acres in Scenario A, and 95 acres in Scenario B, the pivot-oriented cropping system maintains a positive but diminishing net returns advantage over the SDI-oriented system (i.e., from $23 to $17 per acre, respectively). As field size diminishes further to 64 acres in Scenario E and 32 acres in Scenario D, SDI-oriented cropping systems gain in relative net returns. In Scenario E, returns are essentially equal ($1 per acre advantage for pivot-oriented cropping systems), while in Scenario D, the SDI-oriented cropping system has an $11 per acre advantage. In the 80 acre Wiper Scenario, the pivot-oriented cropping system has a $12 per acre advantage over the SDI-oriented cropping system.

The inclusion of nonirrigated acreage in the pivot-oriented cropping system brought about large differences in total income and expenses. However, when examined on a per cropland acre basis, this income effect was fairly consistent across scenarios. In Table 5, the "Total Income" row in the Crop Income section shows the differences in gross revenue brought about by including lower revenue nonirrigated acreage in the pivot cropping system. As indicated in the "Income Difference per acre (SDI – Pivot)" row, the total income difference remains consistently in the $86-$95 per cropland acre range across all acreage scenarios.

Another factor affecting relative net returns of these cropping systems are differences in fixed costs as indicated in the "Fixed Costs" row of the Crop Cost section in Table 5. The pivot-oriented cropping systems consistently had lower total fixed costs than the SDI systems. However, the fixed cost advantage of pivot-oriented systems diminished as field size decreased. These differences are driven by the irrigation system investment cost differences specified in Tables 1 and 2, and are the major reason why the SDI systems become relatively more profitable as field size decreases.

A third factor affecting relative net returns are differences in variable costs caused both by inclusion of lower variable cost nonirrigated acres in the cropping system, and by improved water application efficiencies with SDI systems. The total variable cost differences between the cropping systems, as indicated in the "Variable Costs" and "VC /ac Difference" row of the Crop Cost section of Table 5. These differences remain consistently in the $49 to $54 per cropland acre range across all the field size scenarios, supporting the idea that while variable cost differences are an important factor, they are not the major determinant of differences in profitability between these two alternative cropping-systems. The major determining factor in net revenue differences in this analysis are the differences in fixed investment costs between the center pivot and the SDI irrigation systems.

Sensitivity Of Results To Changes in Key Factors

Sensitivity analysis were used to determine how sensitive these results were to changes in certain key economic factors. Changes caused in the projected net returns of scenarios O (160 acres) and D (32 acres), and the Wiper scenario (80 acres) were calculated in Tables 6, 7, and 8. These scenarios were selected because they represent the extremes in field sizes (scenarios O and D) and a difference in pivot point location (Wiper scenario).

Table 6 shows the effect of price and yield variation on projected returns. Across all scenarios, as corn yields or prices decline the pivot-oriented system becomes relatively more profitable than the SDI system. For Scenario O, the pivot-oriented cropping system has markedly higher net returns than the SDI-oriented cropping system over most of the range of yields and prices presented in Table 6. However, at high yield

Table 5. Summary Income Comparison Across Crop Acreage and Irrigation System Scenarios

	Base Scenario O		Scenario A		Scenario B		Scenario C		Scenario D		"Wiper" Scenario	
	160 acres		127 acres		95 acres		64 acres		32 acres		80 acres	
Item	Pivot	SDI	Pivot	SDI	Pivot	SDI	Pivot	SDI	Pivot	SDI	Pivot	SDI
Cropping System												
Irrigated Acres	125 ac	160 ac	100 ac	127 ac	75 ac	95 ac	50 ac	64 ac	25 ac	32 ac	64 ac	80 ac
Non-Irrigated Acres	35 ac	0 ac	27 ac	0 ac	20 ac	0 ac	14 ac	0 ac	7 ac	0 ac	16 ac	0 ac
A. Crop Income												
Irrigated Corn	$63,750	$81,600	$51,000	$66,770	$38,250	$48,450	$25,500	$32,640	$12,750	$16,320	$32,640	$40,800
Dryland Wheat	$2,730	---	$2,106	---	$1,560	---	$1,092	---	$546	---	$1,248	---
Total Income	$66,480	$81,600	$53,106	$64,770	$39,810	$48,450	$26,592	$32,640	$13,296	$16,320	$33,888	$40,800
Income Difference per acre (SDI – Pivot)	$94.50 /ac		$91.84 /ac		$90.95 /ac		$94.50 /ac		$94.50 /ac		$86.40 /ac	
B. Crop Costs												
Variable Costs	$41,176	$49,845	$32,899	$39,565	$24,664	$29,596	$16,470	$19,938	$8,235	$9,969	$21,003	$24,923
Fixed Costs	$9,833	$19,808	$8,399	$16,306	$6,918	$12,249	$5,327	$7,977	$3,638	$4,573	$6,359	$10,285
Land, Mgmt Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Costs	$51,008	$69,633	$41,298	$55,871	$31,582	$41,844	$21,797	$27,915	$11,873	$14,542	$27,362	$35,208
SDI - Pivot $/acre												
VC /ac Difference	$54 /ac		$52 /ac		$52 /ac		$54 /ac		$54 /ac		$49 /ac	
FC /ac Difference	$62 /ac		$62 /ac		$56 /ac		$41 /ac		$29 /ac		$49 /ac	
TC /ac Difference	$116.53 /ac		$114.75 /ac		$108.03 /ac		$95.59 /ac		$83.42 /ac		$98.07 /ac	
C. Net Returns												
Income less Costs	$15,472	$11,947	$11,808	$8,899	$8,228	$6,606	$4,795	$4,725	$1,423	$1,778	$6,526	$5,592
Total Returns (Pivot – SDI)	+ $3,525		+ $2,909		+ $1,623		+ $70		– $286		+ $934	
Total Returns / Acre (Pivot – SDI)	+ $22.07 /acre		+ $22.90 /acre		+ $17.08 /acre		+ $1.09 /acre		– $11.08 /acre		+ $11.67 /acre	

and price combinations, the SDI system becomes economically competitive. This is the case for the Wiper Scenario as well, where the pivot-oriented cropping system remains more profitable in all cases except for high yield and price combinations. However, the differences in net returns between the cropping systems are less for the 80 acre Wiper scenario than for the 160 acre full circle base Scenario O. In small acreage Scenario D, the SDI cropping system has higher net returns except low yield and price combinations.

Table 7 shows the effect of variation in the life of both the pivot and SDI irrigation systems on projected returns. Across all field size scenarios, changes in the life of the SDI system has a more dramatic effect on net returns than do changes in the life of the center pivot system. While changes in the life of a pivot from 15 to 25 years increases projected net returns per acre by $7 to $20, increases in SDI system life from 5 to 15 years increases projected net returns per acre by approximately $70 to $90. The impact is most pronounced in Scenario D where a increasing SDI irrigation system life from 5 to 10 years while holding pivot life constant at 20 years leads to $66 per acre change in net returns, causing SDI to be more profitable than pivot irrigation. In the Wiper Scenario a 15 year SDI irrigation system life gives an SDI-oriented cropping system a net returns advantage over a corresponding pivot-oriented cropping system with either a 15, 20, or 25 year life.

Table 8 shows the effect of variation in SDI driptape installation cost on projected returns from the two cropping systems. Drip tape costs have a major impact on SDI irrigation systems costs. But for both Scenario O and Scenario D, drip tape cost variation has little effect on whether the pivot-oriented and SDI-oriented cropping systems are more profitable. The pivot cropping system remains the most profitable system for Scenario O and the Wiper Scenario all across the range of drip tape costs considered. However, at the lowest drip tape cost considered in the Wiper Scenario (i.e., $0.02 per foot), the pivot profitability advantage is only $3 per acre. For Scenario D, the SDI cropping system remains the most profitable system across all except the highest cost drip tape alternative (i.e., $0.04 per foot).

Table 6. Effect of Price and Yield Variation on Projected Returns for Center Pivot and SDI Cropping Systems (Pivot Minus SDI Cropping System Returns / Acre)

Base Scenario O: (125 ac. Pivot + 35 ac. W-F) vs 160 ac. SDI				
	Cash Price			
Corn Yields	$2.25/bu	$2.50/bu*	$2.75/bu	$3.00/bu
160	$47	$38	$29	$20
175	$39	$30	$20	$11
190*	$32	$22*	$12	$1
205	$25	$14	$3	($8)
"Wiper" Scenario: (64 ac. Pivot + 16 ac. W-F) vs 80 ac. SDI				
Corn Yields	$2.25/bu	$2.50/bu*	$2.75/bu	$3.00/bu
160	$34	$26	$18	$10
175	$28	$19	$10	$1
190*	$21	$12*	$2	($7)
205	$15	$4	($6)	($16)
Scenario D: (25 ac. Pivot + 7 ac. W-F) vs 32 ac. SDI				
Corn Yields	$2.25/bu	$2.50/bu*	$2.75/bu	$3.00/bu
160	$13	$5	($4)	($13)
175	$6	($3)	($13)	($22)
190*	($1)	($11)*	($21)	($32)
205	($8)	($19)	($30)	($41)

* 190 bushel per acre irrigated corn yields and $2.50 cash price are the standard assumptions in the preceding analysis.

Table 7. Effect of Variation in Irrigation System Life on Projected Returns for Center Pivot and SDI Cropping Systems (Pivot Minus SDI Cropping System Returns / Acre)

Base Scenario O: (125 ac. Pivot + 35 ac. W-F) vs 160 ac. SDI			
	Center Pivot Life		
SDI System Life	15 years	20 years*	25 years
5 years	$72	$76	$78
10 years*	$18	$22*	$25
15 years	($0)	($4)	($7)
"Wiper" Scenario: (64 ac. Pivot + 16 ac. W-F) vs 80 ac. SDI			
SDI System Life	15 years	20 years*	25 years
5 years	$62	$69	$73
10 years*	$5	$12*	$16
15 years	($14)	($7)	($3)
Scenario D: (25 ac. Pivot + 7 ac. W-F) vs 32 ac. SDI			
SDI System Life	15 years	20 years*	25 years
5 years	$43	$55	$63
10 years*	($24)	($11)*	($3)
15 years	($46)	($33)	($26)

* 20 year center pivot life and 10 year SDI system life are standard assumptions in the preceding analysis

Table 8. Effect of Variation in SDI Drip Tape Cost on Projected Returns for Center Pivot and SDI Cropping Systems (Pivot Minus SDI Cropping System Returns / Acre)

Base Scenario O: (125 ac Pivot + 35 ac W-F) vs 160 ac. SDI		
SDI Drip Tape Cost Per Foot	SDI System Costs Per Acre	CP – SDI Net Returns Per Acre
$0.02	$452	$9
$0.025	$495	$15
$0.03*	$539*	$22*
$0.035	$583	$29
$0.04	$626	$35
"Wiper" Scenario: (64 ac Pivot + 16 ac W-F) vs 80 ac. SDI		
SDI Drip Tape Cost Per Foot	SDI System Costs Per Acre	CP – SDI Net Returns Per Acre
$0.02	$483	$3
$0.025	$527	$7
$0.03*	$570*	$12*
$0.035	$614	$16
$0.04	$657	$21
Scenario D: (25 ac. Pivot + 7 ac. W-F) vs 32 ac. SDI		
SDI Drip Tape Cost Per Foot	SDI System Costs Per Acre	CP – SDI Net Returns Per Acre
$0.02	$577	($24)
$0.025	$621	($18)
$0.03*	$664*	($11)*
$0.035	$708	($4)
$0.04	$751	$2

* The assumed drip tape cost in the preceding analysis is $0.03 per foot.

CONCLUSIONS

This cropping system-oriented analysis demonstrates a distinct net returns advantage for pivot-oriented cropping systems over SDI-oriented cropping systems for fields of 160 acres. However, as field size decreases, the net returns advantage of pivot-oriented cropping systems over SDI systems declines to the point where SDI cropping systems returns are projected to be greater.

The primary factor affecting relative profitability is the per acre investment cost required to establish either the pivot or SDI irrigation systems on the size of field in question. SDI systems have greater proportional adjustability than do center pivot irrigation systems. This is illustrated by the steady, if not dramatic, increase in per acre pivot irrigation system costs as field size declines in comparison to the relatively steady per acre cost levels for SDI irrigation system investments. Differences in variable and fixed costs, revenue, and net returns between the irrigated corn and the nonirrigated summer fallow wheat enterprises impact the comparison of overall net revenue between the pivot and SDI-oriented cropping systems, resulting in lower gross revenue and variable costs for the pivot-oriented cropping systems. However, relative capital or fixed costs between pivots and SDI are the key determinants of the relative profitability of these two cropping systems.

These results are most sensitive to assumptions about the life of the SDI irrigation system. Although assumed to have a 10 year life, if an SDI system only lasts 5 years, it essentially becomes non-competitive in a net returns sense with pivot-oriented cropping systems across all the field size scenarios. Conversely, if an SDI system has a 15 year life, it becomes more profitable in all scenarios. Changes in prices and yields have a major impact on the projected net returns of the cropping systems. However, such price and yield changes do not have a noticeable impact on the choice among alternative irrigation systems based on comparative net returns results. To a lessor extent, changes in drip tape costs affect the relative profitability of pivot versus SDI-oriented cropping systems, but do have a major effect on the profitability of SDI-oriented cropping systems.

Future research should be oriented toward developing reliable information on the longevity of SDI irrigation systems and on the costs of renovating them. Also, further work is needed to document the potential water use efficiencies and uniform application benefits for SDI irrigation systems relative to center pivot irrigation systems. Additionally, an analysis is needed about how, in western Kansas, increased production risk and lower projected income for nonirrigated acres relative to irrigated acres may influence a crop producer's willingness to select irrigation systems that provide higher proportions of irrigated acreage for a given piece of farmland. From a farm financial management perspective, potential implications of placing a center pivot on a flood irrigated field may have land valuation and tax management impacts that should be understood. Finally, ongoing efforts are needed in the design and development of efficient, low cost center pivot and SDI irrigation systems.

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⇒ Communicate information to farmers and the general public about agricultural irrigation.

⇒ Encourage cooperation among all segments of the industry.

⇒ Promote a closer liaison with financing agencies.

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