9-24-73
5M

FACT SHEET

L-1132

PROFIT PLANNING FOR IRRIGATED FARMING

Peter J. Barry, Kenneth E. Graeber and Tom E. Prater*

Steps involved in an orderly process of investment analysis apply to resource adjustment in irrigated farming. Key questions relate to the manager's life cycle, objectives, planning horizon and initial investment requirements; the investment's lifetime, earnings, financing terms and financing cash flows; and alternative investments and risks. All these data can be combined in capital budgeting analyses to compare investment alternatives in terms of the present values of their net cash flows.

Capital budgeting analysis was applied to an investment in irrigation equipment and adjustment from production of dryland grain sorghum to irrigated corn. Budgets were based on a well pumping 1,800 gallons per minute and servicing 250 acres. Data on investment and financing requirements, annual cash flow projections and returns variability were analyzed to determine present values for alternative discount rates and planning horizons.

The irrigation investment appears favorable, from a returns standpoint, over a relatively long planning period (8 to 15 years) and has low rates (less than 5 to 6 percent) of return on alternative investments. This payoff period is too long for many managers. Cash flow commitments to repay borrowed funds and interest tend to magnify any variation of returns, increase potential equity loss and make the farmer's risk position more vulnerable. A primary consequence of this financial risk is the firm's increased need for liquidity. At the same time, borrowing depletes the firm's credit reserve and can severely reduce repayment capacity for subsequent investment alternatives.

On the other hand, the reduction in expected yield variability and in net income variability may be extremely important to the producer. It may outweigh his loss of liquidity from borrowing and even enable him to safely carry higher debt levels.

*Assistant professor, Department of Agricultural Economics, Texas Agricultural Experiment Station; Extension area economist-management, Uvalde, and Extension economist-management, respectively, The Texas A&M University System

Irrigation and Decision Consideration

Periodic drouth conditions cause many farmers in southwest central Texas to suffer extreme variability in returns from producing dryland grain sorghum. Some successfully reduce this variation and increase returns by drilling wells, installing irrigation equipment and shifting production to irrigated corn. Accordingly, interest is high in designing an analysis to test the feasibility of changing from dryland grain sorghum to irrigated corn. Water supplies in southwest central Texas appear adequate for irrigation expansion. Corn produced under irrigation exhibits stable yields with ready markets available.

Cost of the well and irrigation equipment, however, is quite high. The long payoff period required concerns many farmers approaching retirement. Other investment choices allowing more favorable timing of returns may make an irrigation investment unwise.

Data Sources

To test the feasibility of an irrigation investment, data on investment requirements, financing, costs, returns and variability of sorghum and corn yields were obtained from a panel of producers, Extension personnel and other businessmen. These data were analyzed in a capital budgeting formulation in which the discounted net cash flows, including the annual equity in the irrigation equipment, were compared to the initial equity in the investment. The analysis includes only cash flow items that *change* as a result of an irrigation investment.

The selected budgets are based on one well servicing 250 acres, a common unit. Table 1 indicates investment requirements for irrigation equipment and a distribution system including a 1,500-foot well pumping 1,800 gallons per minute and a diesel engine used 2,000 hours annually. Annual

The Texas A&M University System • Agricultural Extension Service • John E. Hutchison, Director • College Station

Table 1. Initial investment requirements for a 1500-ft. well and 250-acre distribution system in the Edwards Aquifer area of Texas.

Item	Cost
Well	$26,070
Pump and drive	6,500
Diesel engine	8,000
Pipe distribution system	17,000
Land leveling	1,000
Total	$58,570

depreciation of $3,380 is based on an expected life of 7 years for the diesel engine and 20 years for all other items in the irrigation system.

Table 2 indicates selected per-acre estimates of costs, returns and yield variability for dryland sorghum and irrigated corn. The change in net cash returns on crops due to the investment was calculated by deducting the expected returns on 250 acres of sorghum from the expected returns on 250 acres of corn. To account for the time needed for managerial adjustment to new irrigation equipment, returns from irrigated corn were budgeted on the basis of 80 percent of normal capacity the first year, 90 percent of normal capacity the second year and full capacity thereafter.

Capital Budgeting Analysis

Table 3 indicates projected cash flows for a 13-year period resulting from the irrigation investment and change of 250 acres from dryland grain sorghum to irrigated corn. In this case, the manager or operator is assumed to have provided the $58,570 required by irrigation equipment without need for external financing. Column C indicates the net gain on cash flow after income tax payment. Column D indicates remaining equity in the investment.

Table 4 summarizes net present values of the sum of projected cash flows for alternative discount rates and planning horizons.* Included in the present value calculation is the equity or depreciated value of irrigation equipment for the final year of the respective planning horizon. Because this terminal value could be recovered by the manager or operator if liquidation occurred, its value should be included in the analysis.

Table 2. Projected estimates of costs, returns, and yield variability per acre of grain sorghum and irrigated corn.

Item	Dryland grain sorghum		Irrigated corn
Gross receipts[1]	$37.00		$130.00
Operating costs[2]			
Pre-harvest	14.06		66.44
Harvest	5.00		17.60
Total	19.06		84.04
Net cash income	$17.94		$ 45.96
Net grain from corn		28.02	
Expected yield range, 9 years out of 10[3]	900-3800 (lb.)		90-110 (bu.)

[1]Receipts based on 100 bu. of corn at $1.30 per bu. and 20 cwt. of sorghum at $1.85/cwt.
[2]Operating costs include seed, fertilizer, pesticide, machinery, tractor, irrigation, labor, truck, interest on operating capital and custom harvest.
[3]Producer estimates.

Table 3. Projected net cash flows resulting from investment in irrigation equipment and shift of 250 acres from dryland sorghum to irrigated corn production.

Year	Net cash gain from irrigation[1]	Income tax[2]	Annual net cash flow to manager	Depreciated investment value
	A	B	C	D
1	$ 505	$ 0	$ 505	$55,190
2	3,755	0	3,755	51,810
3	7,005	160	6,845	48,430
4	7,005	556	6,449	45,050
5	7,005	556	6,449	41,670
6	7,005	556	6,449	38,290
7	7,005	556	6,449	34,910
8	7,005	556	6,449	31,530
9	7,005	556	6,449	28,150
10	7,005	556	6,449	24,770
11	7,005	556	6,449	21,390
12	7,005	556	6,449	18,010
13	7,005	556	6,449	14,640

[1]Net gain assumes that returns from corn are 80% of capacity in year one, 90% in year two, and 100% thereafter.
[2]Tax rates were levied on net cash gain after annual depreciation of $3,380 on irrigation equipment. Income earned prior to irrigation was not subject to tax because of personal exemptions and tax deductions.

*Present values are derived by discounting future returns back to a value at present. The discounting procedure accounts for the time value of money. A dollar available one year from now has less present value than a dollar available now, even with no changes in its purchasing power. The reason is that a present dollar can be invested to yield more than one dollar in the future. In fact, the present value of the dollar in one year is $\$1/1+i$, where i is the discount rate. The discount rate reflects an individual's opportunity cost or rate of return in the next best use of his money. If a bank's savings account paying five percent interest is the next best use of money, then the discount rate should be 5 percent. A dollar invested at present will yield $1.05 in one year; similarly, the present value of the $1.05 to be received in 1 year is $1. In addition, the present value of a dollar in year ten is $\$1/(1+i)^{10}$ or $.61 for a discount rate of 5 percent. The present value of a stream of annual returns (R_n) is the sum (Σ) of the annual (n) returns each discounted to the present:

$$PV = \sum_n \frac{R_n}{(1+i)^n}$$

The purpose of capital budgeting is to choose an investment-financing package with the highest present value of future net cash flows.

Net present values are calculated by use of the following equation:

$$NPV = \sum_{n=1}^{N} \frac{R_n}{(1+i)^n} + \frac{E_N}{(1+i)^N} - 58{,}750$$

where ΣR_n = the summation of annual (n) net cash flows (R) for each year (n = 1, 2, . . . N)

E_N = equity or depreciated value of the irrigation investment in year N.

i = the discount rate.

All these elements of investment decisionmaking can be combined in capital budgeting analyses. Capital budgeting involved comparing investment alternatives in terms of the present value of their net cash flows which represent returns that can be withdrawn by the manager or reinvested in the business. This method accounts for differences in both *level* and *timing* of all cash flows affected by investment decisions.

Discounted cash flow analysis indicates that the existence of profitable alternative investments, as reflected by the value of the discount rate, increases the required amount of payback from the irrigation investment. In turn, payback period is extended. Under the 6-year planning period, for example, the irrigation investment generates positive net present values only with discount rates less than 4 percent. Similarly, with a 12-year horizon, positive net present values occur only with discount rates less than 6 percent. Alternative uses for the initial investment yielding more than a 5 percent return over the 12-year period may make the irrigation investment uneconomical. Reduction in variability of annual returns, however, casts the irrigation investment in a more favorable light.

Table 4. Net present values of projected cash flows and investment equity for irrigation investment for alternative planning horizons and discount rates; no external financing.

Discount rate	Years: 6	8	10	12
.00	$10,172	$16,310	$22,448	$28,586
.02	3,064	7,138	10,993	15,385
.04	−2,367	47	2,636	5,370
.05	−5,031	−3,299	−1,317	870
.06	−7,537	−6,430	−4,962	−3,230

Generally, farm managers do not have sufficient funds for investments and must rely on external financing. Terms of such financing may influence investment decisions. Financing easily can be included in an analysis by calculating the present value of cash flows to the manager after financing transactions are accounted.

The manager could choose from several sources of loan funds such as federal land banks, commercial banks, production credit associations, insurance companies and individuals. Based on recent loan policies and economic conditions, we will assume the borrower could obtain a 20-year loan at 7 percent interest requiring a 20 percent down payment and repayable in equal annual payments of $4,413. Under these terms, the investment of $58,570 requires an $11,714 down payment and a loan of $46,856. Alternatively, the farmer could obtain a 100 percent loan by pledging other real estate as security. Any pre-existing mortgages, however, would have to be refinanced under the 20 year, 7 percent terms. Finally, we also assume that the farmer can obtain an annual operating loan at 8 percent interest to maintain a positive cash balance in early years of the investment. Any out-

Table 5. Projected net cash flows and investment equity from irrigation investment with external financing.

Year	Net gain from irrigation	Loan payment	Cash balance (A-B)	Operating loan balance[1]	Annual net cash flow to manager	Equity in investment[2]
	A	B	C	D	E	F
1	$ 505	$4,413	$−3,908	$4,220	$ 0	$ 5,247
2	3,755	4,413	−658	5,268	0	2,032
3	7,005	4,413	2,592	3,097	0	2,121
4	7,005	4,413	2,592	792	0	2,435
5	7,005	4,413	2,592	0	1,737	1,333
6	7,005	4,413	2,592	0	2,592	−457
7	7,005	4,413	2,592	0	2,592	−2,136
8	7,005	4,413	2,592	0	2,592	−3,696
9	7,005	4,413	2,592	0	2,592	−5,129
10	7,005	4,413	2,592	0	2,592	−6,425
11	7,005	4,413	2,592	0	2,592	−7,621
12	7,005	4,413	2,592	0	2,592	−8,618
13	7,005	4,413	2,592	0	2,592	−9,448
14	7,005	4,413	2,592	0	2,592	−10,100
15	7,005	4,413	2,592	0	2,592	−10,561

[1]Balance required to balance cash flow includes interest at 8 percent on outstanding loan balance.

[2]Equity is the difference between depreciated value of the irrigation investment and debt outstanding (short- and long-term) on the real estate debt.

standing operating loan balance would have to be repaid as soon as funds became available.

Table 5 indicates calculations of annual net cash flow to the manager (column E) and his annual equity in the irrigation investment (column F). The difference in cash flow patterns when external financing and associated repayments are introduced is quite evident. During the first 4 years, net cash flows to the manager are zero. All surplus cash is used to repay loans. The rest of his business must provide sufficient funds for family consumption during this period. In the fifth year, the irrigation investment begins to generate cash which is available for family consumption, reinvestment in the business or other investments. On the other hand, the manager's equity in his irrigation investment declines because of depreciation and the amortized debt repayments which slowly reduce the outstanding loan balance. Of course, the future value of the irrigation equipment may or may not actually decline according to the depreciation schedule.

Table 6 summarizes net present values of the externally finance irrigation investment for alternative discount rates and planning horizons. Net

Table 6. Net present values of projected cash flows and investment equity for irrigation investment with external financing for alternative planning horizons and discount rates.

Discount rate	Years			
	12	13	14	15
.00	$− 451	$1,311	$3,251	$5,382
.02	−1,740	−248	1,364	3,099
.03	−2,332	−960	511	2,071
.04	−2,881	−1,615	−270	1,135
.05	−3,398	−2,231	−1,015	251
.06	−3,889	−2,821	−1,708	−568

present values are calculated by use of the following equation:

$$NPV = \sum_{n=1}^{N} \frac{R_n}{(1+i)^n} = \frac{E_N}{(1+i)^N} - 11{,}714$$

The relatively high interest rates on loans and the required debt repayments have the effect of severely extending payoff periods and lowering rate of returns. Even with a zero discount rate, a positive net present value is not attained until the thirteenth year. Higher discount rates extend the payoff period; in fact, positive net present values are achieved only with discount rates less than 6 percent for a planning period of 15 years. And under assumed loan interest rates, discount rates are likely to exceed 6 percent.

Farmers might reject the irrigation investment to seek other routes of expansion or stabilization of returns imposing less pressure on cash flows. The expected net present value of the irrigation investment then could be compared with other agricultural investments.

Because dryland grain sorghum producers already have substantial pressure on their cash flow due to large annual variations in returns, producers probably could consider the increased stability of corn production to more than compensate for the long payoff period. While risk preferences are difficult to quantify, they are an essential part of the analysis.

The risk of social controls on water use is particularly difficult to quantify. Heavy irrigation by area farmers might divert substantial supplies of water from other users, including nearby metropolitan areas. A likely response would be political action to control uses of water and insure adequate water supplies for other uses. This risk is real but nearly impossible to incorporate in capital budgets.

Successful Decisionmaking

Final investment decisions depend on orderly analyses utilizing specific situation data. Capital budgeting techniques, widely used in agriculture, are particularly useful in accounting for differences in level and timing of cash flows affected by investment decisions. Only by considering all relevant factors can a manager make valid decisions to solve specific problems in a manner consistent with his objectives, and in borrowing from agricultural lenders.

Acknowledgments

The authors are extremely grateful for the assistance given by Medina County Extension Agent Glenn Bragg and the Medina County Program Building Committee in compiling data.

Cooperative Extension Work in Agriculture and Home Economics, The Texas A&M University System and the United States Department of Agriculture cooperating. Distributed in furtherance of the Acts of Congress of May 8, 1914, as amended, and June 30, 1914.
5M—6-73