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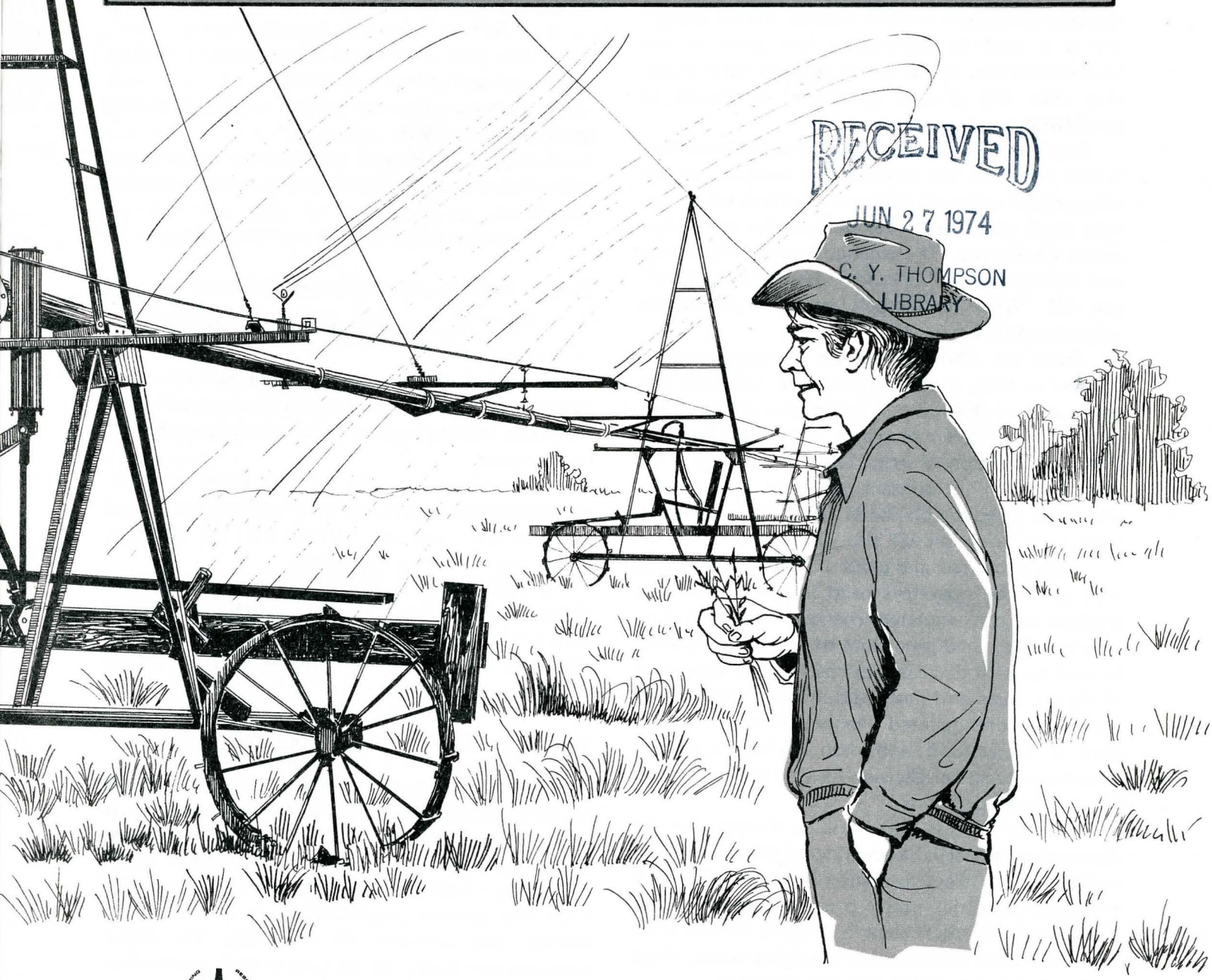
EC 74-861

Estimating the Most Profitable Use of CENTER-PIVOT IRRIGATION for a Ranch



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Sprinklers have enabled Nebraska farmers and ranchers to irrigate lands formerly considered too rough or too sandy.

Center-pivot irrigation is currently the most popular sprinkler method because of a low labor requirement compared to other methods that require moving distribution lines, and a low capital requirement compared to present solid-set sprinkler systems.

The adoption of irrigation creates changes in the cost-and-return income stream. Partial budgeting is a tool for estimating this physical and financial impact. If the change appears more profitable than the present operation, it should be considered.

In a ranching operation which has not previously had irrigation, the rancher may want to consider using added irrigation in more than one way. If so, he'll need separate partial budgets for each alternative considered. The evaluation will help answer two questions—(1) "Should I develop irrigation?" and (2) "What is the best way for me to use irrigation on my ranch?"

There are many differences between farms or ranches in soils, cropping programs, livestock programs and in abilities and tendencies of the operators. These differences create varied starting positions for adoption of irrigation. Since change infers change "from" a present situation and present situations vary, the choice of which alternative use to make of irrigation will also vary.

Since situations and goals of individuals vary, as well as prices, operators need to make their own analysis of contemplated changes on their future income. The same procedure of grouping increases in income with decreases in costs to compare with increased costs and decreased income, can be used for many contemplated changes. Once the procedure is understood and used, partial budgeting becomes a practical decision-making tool for many farm or ranch decisions.

The rest of this circular is an **example** of the application of partial budgeting to the question of which crop to select for center-pivot irrigation in a particular Sandhills ranch situation. Blank spaces are provided in the example budgets for the users estimates under conditions of changing prices. Steps useful to the analysis for this situation are:

Step 1. Define the Present Situation

List characteristics of the ranch pertinent to irrigation development and the choice of crops to irrigate. For example:

1. There is no irrigation in the operation at present.
2. A suitable site for a 130-acre system exists on dryland range.
3. The ranch is stocked to capacity with 650 spring-calving cows.
4. A 92% calf crop is being weaned.
5. No corn machinery, silage storage, feeding equipment or facilities are owned.
6. Adequate hay equipment for expanded hay production is owned.
7. Cows, bulls and replacement heifers are being fed supplemental purchased protein during the winter.
8. Summer range for rent is unavailable.

Step 2. List Alternative Changes to Consider

1. Add irrigated pasture and increase the number of cows carried.
2. Add irrigated pasture. Hold enough steer calves back from fall sale to utilize the production from the irrigated pasture during winter and summer periods.
3. Add irrigated corn. Produce silage for backgrounding steer calves. Harvest corn not needed for silage as grain and sell. Custom hire the planting, tillage and harvesting operations.
4. Add irrigated alfalfa. Harvest with present equipment. Replace presently purchased protein with alfalfa up to the protein needs of the herd. If more hay is produced than needed, the extra alfalfa hay will be sold.

Step 3. List Changes Common to All Alternatives

Changes common to all alternatives do not need to be included in the individual partial budgets in order to examine differences between alternatives. However, they should not be forgotten when evaluating whether an alternative is more profitable than the present organization. If the common changes are evaluated at this stage, the dollar amounts can easily be inserted in each alternative.

There are two major dollar items and one assumption (the author's) common to all four alternatives.

Item 1 is that regardless of which crop alternative is selected, the dryland production of 130 acres of range will be given up. It is estimated that this will reduce income by $3.50 per acre or $455.

Item 2 is that the fixed costs of depreciation, interest, taxes, insurance and repairs on the irrigation system are the same for all alternatives. These costs are estimated at $24 per acre or $3,120 annually.

The assumption that affects all alternatives is that regardless of which crop is produced, the primary purpose will be for providing additional feed. The feed is produced so that the total size of the ranch business can be expanded. Since at least part of the feed produced with any alternative will be used on the ranch, it is necessary to estimate the changes in feed production, kind and number of cattle, feed requirements of additional cattle and feed sales or purchases. These physical changes will be used as a basis for calculating changes in the costs and returns.

Step 4. Estimate Changes in Feed Supply, Kind and Number of Cattle, Feed Requirements and Purchase or Sale of Feed and Livestock.

This is not necessary if all irrigated crops are to be sold rather than fed. This step appears on the page opposite the partial budget to which it corresponds.

Step 5. Develop a Partial Budget for Each Alternative.

Partial budgets put together the considerations which are negative and those which are positive. The positive considerations are increased income and decreased costs. The negative considerations are increased costs and decreased income.

Partial budgets in this example are each shown on a separate page and, for convenience, are placed opposite the alternatives listing physical changes. A one-page completed partial budget has three distinct parts. The specific contemplated change at the top of each example is one part (Step 2). The partial budget itself is an economic appraisal of the change (Step 5) and is the second part.

Step 6. List Other Considerations

Other considerations at the end of each example are for listing factors not included in the economic estimate. These considerations may be very important. A careful listing of them should be made for each alternative. They are the third part of the completed partial budget.

Alternative 1. Irrigated Pasture and Cows. Feed and Livestock Changes

Additional Forage Production		Your Estimates	
130 acres x 12 AUM's[a] per acre	1,560 AUM's	_____	AUM's
Additional Ranch Carrying Capacity			
1,560 AUM's ÷ 15.6 AUM's/cow unit[b]	100 cow units	_____	cow units

Increased Cattle Production

Work at the University of Nebraska North Platte Station indicates conception rates for cows bred on irrigated pasture are higher by approximately 5% than for cows bred on native range. Assuming that half the 750-cow herd, now possible with irrigated pasture, can be stocked during breeding on irrigated pasture, increased efficiency can be estimated.

375 cows x .05	19 calves	_____	calves
100 cows capacity increase x 92%	92 calves	_____	calves
Total increased calf production	111 calves	_____	calves

Increased Cattle for Sale

Steer calves: 111 ÷ 2	55 steers	_____	steers
Heifer calves: (111-55 steers)-15 repl	41 heifers	_____	heifers
Cull cows[c]	14 culls	_____	culls

Additional Feed Required

Since the irrigated pasture is providing the forage needs of the additional cow units, additional feed consists of protein supplement for 100 additional cow units.

		Pounds Per Animal	Total	
Cows:	1 lb/day x 90 days	90		
	1.75 lb/day x 75 days	132		
	100 cows x	222	22,200	_____ #
Heifers:	1 lb/day x 90 days	90		
	2 lb/day x 75 days	150		
	15 heifers x	240	3,600	_____ #
Bulls:	2 lb/day x 165 days	330		
	4 bulls x	330	1,320	_____ #
			27,120	_____ #
			or 13.5 tons	_____ T

[a] *North Platte experimental data indicates 13 AUM's/A. Surveys of producers over two years indicate 9.5-10.0 AUM's/A.*

[b] *Forage requirements per cow unit includes the cow, replacement heifer and bull for 12 months.*

[c] *Note that death losses were not computed on steer and heifer calves. Death losses are accounted for to some degree by selling one less cull cow than the number of replacement heifers going back into the herd.*

Example Partial Budget — Alternative 1

Contemplated changes: Add 130 acres of irrigated grass. Increase the ranch carrying capacity by 100 cows with replacement heifers and bulls. Increase the number of calves weaned by 111 head. Additional animals for sale - 55 steer calves, 41 heifer calves, 14 cull cows.

		Your Estimate
Increased Income		
55 steer calves x 425 lb x $0.50	$11,687	_____
41 heifer calves x 405 lb x $0.45	7,472	_____
14 cull cows x 900 lb x $0.25	3,150	_____
Total increased income	$22,309	_____
Decreased Costs	**None**	_____
Total Positives	$22,309	_____
Increased Costs		
Irrigation fuel and oil: 130 acres x $12.50	$ 1,625	_____
Fertilizer: 130 acres x $22	2,860	_____
Prorated seeding costs: 130 acres x $6	780	_____
Maintenance of irrigation system	130	_____
Fence and stock water maintenance	130	_____
Interest on cows: 100 cows x $400 x .075%	3,000	_____
Taxes on cows: 100 cows x $2	200	_____
Salt and mineral: 100 cows x $2	200	_____
Veterinary and medicine: 100 cows x $1.50	150	_____
Winter protein: 13.5 tons x $180	2,430	_____
Fixed costs of irrigation system	3,120	_____
Other _____	____	_____
_____	____	_____
Total increased costs	$14,625	_____
Decreased Income		
Dryland production of 130 acres	$ 455	_____
Total negatives	$15,080	_____
Net Change - Positive	**$ 7,229**	_____

Other Considerations

The availability of capital for additional cows—approximately $40,000.

The availability of labor for 100 additional cows.

The effect of irrigated pasture on the dryland grazing patterns of the ranch and on keeping a balanced feed supply for winter and summer.

Changes in the cash flow of the ranch and income tax reporting.

Whether summer range is available for rent.

Alternative II. Irrigated Pasture and Steers. Feed and Livestock

If steer calves are kept back from fall sale, wintered and then grazed on irrigated grass, how many steers will be needed to consume the 1,560 AUM's of irrigated forage?

During the winter period, November 1 to May 10, each weaned calf is equivalent to about 0.5 animal unit.

0.5 x 6.33 months - 3.2 AUM's of feed required.

During the grazing season, May 10 to October 10, each steer is equivalent to about 0.65 animal unit.

0.65 x 5 months = 3.25 AUM's.

1.560 ÷ 6.5 AUM's = 240 steer calves.

Your estimate _____ steer calves

These 240 steer calves will consume half or 780 AUM's of irrigated forage during the summer. Seven hundred and eighty AUM's can be put up for hay.

780 ÷ 3 AUM's/ton = 260 tons of hay.

Your estimate _____ tons

The quality of hay from the irrigated forage is considered to contain a protein level high enough for wintering steer calves without additional purchased supplement.

Net Changes in Cattle Numbers

240 fewer steer calves sold in November.

Your estimate _____ calves

1% death loss.

238 additional steers sold in October.

Your estimate _____ steers.

Example Partial Budget – Alternative II

Contemplated changes: Add 130 acres of irrigated pasture and hay. Two hundred forty steer calves to be held back from November sale, wintered on range and hay, grazed on irrigated grass and sold in October. One % death loss.

		Your Estimate
Increased Income		
238 steers x 775 lb x $0.43	$79,313	_____
Decreased Costs	**None**	_____
Total positives	$79,313	_____
Increased Costs		
Irrigation fuel and oil: 130 acres x $12.50	$ 1,625	_____
Fertilizer: 130 acres x $22	2,860	_____
Prorated seeding costs: 130 x $6	780	_____
Maintenance of irrigation system	130	_____
Fence and stock water maintenance	130	_____
Haying costs: 260 tons x $4.50	1,170	_____
Interest on steers: 240 steers x $212 x .075%	3,816	_____
Taxes on steers: 240 steers x $1	240	_____
Salt and mineral: 240 steers x $1	240	_____
Veterinary and medicine: 240 steers x $1.25	300	_____
Fixed costs of irrigation system	3,120	_____
Other _____	____	_____
_____	____	_____
Total increased costs	$14,411	_____
Decreased Income		
240 steer calves x 425 lb x $0.50	$51,000	_____
Dryland production of 130 acres	455	_____
Total decreased Income	$51,455	_____
Total negatives	$65,866	_____
Net Change - Positive	**$13,447**	_____

Other Considerations

The change in cash flows and income tax reporting by holding back steers one year for sale in the following year.

The labor requirement for putting up 260 additional tons of hay.

The labor requirement for wintering 240 steer calves.

Alternative III. Irrigated Corn Silage and Grain With Backgrounded Steers — Feed and Livestock Changes

Number of Steers

The 650-cow herd will produce about 300 steer calves which will be kept for backgrounding. Irrigated corn is estimated to produce 16 tons of "cured" silage or 130 bushels of grain per acre. Each steer calf held for backgrounding will require about 1.1 tons of silage, 0.6 tons of native hay, and 160 lb of protein.

Estimated feed requirements for 300 backgrounded steer calves are:

		Your Estimate
Silage:	300 head x 1.1 tons = 330 tons	_____ T
Hay:	300 head x 0.6 tons = 180 tons	_____ T
Supplement:	300 head x 160 lb = 48,000 lb or 24 tons	_____ T

Corn Production

At a yield of 16 tons of "cured" silage per acre, only 21 of the 130 irrigated acres will be needed for silage production. One hundred and nine acres of corn grain will be available for sale.

109 acres x 130 bushels = 14,170 bushels. Your estimate _____ Bu

Estimated Net Change in Cattle Numbers

300 steer calves not sold in November. Your estimate _____ calves.
1.3% death loss
296 steers sold in April Your estimate _____ steers.

Example Partial Budget—Alternative III

Contemplated changes: Add 130 acres of irrigated corn. Twenty-one acres of silage required for backgrounding 300 steer calves. One hundred nine acres or 14,170 bushels of corn to be sold. Corn tillage, planting, cultivation and harvesting for grain and silage to be custom hired. A feed wagon, silo, fence-line bunks and backgrounding lot to be added.

		Your Estimate
Increased Income		
Corn: 14,170 bushels x $1.25	$ 17,712	_____
Steers: 297 x 675 lb x $0.45	90,214	_____
Total increased income	$107,926	_____
Decreased costs	**None**	_____
Total positives	$107,926	_____
Increased Costs		
Custom disking: 130 acres x 2 times x $2	520	_____
Custom plant: 130 acres x $3	390	_____
Seed: 130 acres x $7.50	975	_____
Herbicide: 130 acres x $2.50	325	_____
Custom cultivate: 130 acres x $2	260	_____
Irrig. fuel and oil: 130 acres $12.50	1,625	_____
Fertilizer: 130 acres x $22	2,860	_____
Maintenance of the irrigation system	130	_____
Custom silage harvest: 21 acres x $45	945	_____
Custom grain harvest: 14,170 bushels x $0.15	2,125	_____
Haul corn to market: 14,170 bushels x $0.05	708	_____
Additional protein: , 24 tons x $180	4,320	_____
Native hay: 180 tons x $18	3,240	_____
Veterinary and medicine: 300 calves x $2.50	750	_____
Salt and mineral: 300 calves x $1.50	450	_____
Taxes on steers: 300 calves x $1.50	450	_____
Interest: 300 calves x $200 x .075% x 0.5 year	2,250	_____
Silage feeding costs: 336 tons x $2	672	_____
Fixed costs of silo, feed wagon, lots and bunks	840	_____
Fixed costs of irrigation system	3,120	_____
Other _____	_____	_____
_____	_____	_____
Total Increased Costs	$26,955	_____
Decreased Income		
Steer calves: 300 x 425 lb x $0.50	$ 63,750	_____
Dryland production of 130 acres	455	_____
Total decreased income	$ 64,205	_____
Total Negatives	$ 91,160	_____
Net Change — Positive	**$ 16,766**	_____

Other Considerations

The changes in cash flows and income tax reporting.
The labor for backgrounding calves.
The availability of custom hiring the corn operations.
The capital required for feed wagon, bunks, lots and silo.
The feed from 109 acres of cornstalks.

Alternative IV. Alfalfa Fed—Protein Replaced

Alfalfa Production

At 4.5 tons/A yield, the 130 acres will produce 585 tons.
Your estimate _____ tons.

Alfalfa Required		Pounds	Your Estimate
Cows:	4 lb/day x 90 days x 650	234,000	_____ #
	6 lb/day x 75 days x 650	292,500	_____ #
Heifers:	4 lb/day x 90 x 97	34,920	_____ #
	7 lb/ day x 75 x 97	50,925	_____ #
Bulls:	6 lb/day x 165 days x 26	25,740	_____ #
Total alfalfa required		638,085	_____ #
		or 319 tons	_____ T

For Sale: 585 - 319 = 266 tons for sale. Your estimate for sale _____ T

Effect on Native Hay Required

The alfalfa fed will replace some of the native hay being fed. A Sandhills rancher using this program reports that a pound of alfalfa replaces nearly a pound of native hay.

319 T alfalfa x 94% = 300 T less native hay needed _____ T

This offers alternatives for:

1. Cutting 300 T less native hay and running additional cows, about 40 more cow units on a grass-hay diet).
2. Selling excess native hay (used in budget).

Protein Replaced		Pounds	Your Estimate
Cows:	1 lb/day x 90 days x 650 cows	58,500	_____ #
	1.75 lb/day x 75 x 650 cows	85,312	_____ #
Heifers:	650 x 15% = 97 heifers		
	1 lb/day x 90 days x 97 heifers	8,730	_____ #
	2 lb/day x 75 x 97 heifers	14,550	_____ #
Bulls:	650 x 4% = 26 bulls		
	2 lb/day x 165 days x 26	8,580	_____ #
Total protein replaced		175,672	_____ #
		or 88 tons	_____ T

Example Partial Budget — Alternative IV

Con templated changes: Add 130 acres of irrigated alfalfa. Replace purchased protein with alfalfa for wintering cows. Decrease the amount of native hay fed by the same number of tons as the amount of alfalfa fed. Three cuttings of alfalfa with 4.5 tons per acre total yield. Alfalfa harvesting done with presently owned equipment.

		Your Estimate
Increased Income		
Alfalfa hay: 266 tons x $25 baled	$ 6,650	_____
Native hay: 300 tons x $18	5,400	_____
Total increased income	$12,050	_____
Decreased Costs		
Protein: 88 tons x $180	$15,840	_____
Total positive	$27,890	_____
Increased Costs		
Irrigation fuel and oil: 130 acres x $15	$ 1,950	_____
Fertilizer: 130 acres x $6	780	_____
Prorated seeding costs: 130 acres x $6	780	_____
Maintenance of the irrigation system	130	_____
Windrow: 3 cuttings x 130 acres x $2	780	_____
Baling: 585 tons x $3.60	2,106	_____
Haul and stack bales: 585 tons x $1	585	_____
Feeding bales: 585 tons x $1	585	_____
Fixed costs of the irrigation system	3,120	_____
Other _____	_____	_____
_____	_____	_____
Total increased costs	$10,816	_____
Decreased Income		
Dryland production of 130 acres	$ 455	_____
Total negatives	$11,271	_____
Net Change — Positive	**$16,619**	_____

Other Considerations

The bales from each cutting must be moved from under the sprinkler.
The changes in labor requirement for handling the additional hay.
Labor and equipment for feeding of hay instead of cake.
Whether the windrower and baler are owned.
Whether alfalfa hay can be purchased.

Summary

Among the example budgets, Alternative IV with alfalfa appears to be slightly less profitable than corn. The sum of the increased costs and decreased income for alfalfa is $11,271. At the computed yield of 585 tons, the cost is about $19.25 per ton. Unless it is the program of the ranch to purchase protein, and the protein cost is $180 or more per ton, this alternative would not be so profitable.

In the corn-backgrounding alternative, custom rates were used. If custom hiring is not available and all the machinery for corn growing and silage feeding needs to be purchased, the investment in machinery per acre on the basis of 130 acres will be sizable. The fixed and variable costs of this machinery per acre would very likely be higher than the custom rates. A quick estimate of the annual fixed costs for corn machinery can be made by multiplying the anticipated machinery investment by 18%.

In Alternatives II and III, which involve holding steer calves from one year to the next, beef selling prices are critical factors. Each one cent difference in selling price of steers creates a $1,844.50 difference in increased income in Alternative II and a $2,004.75 difference in Alternative III.

Decisions can be made on other than a potential profit basis. Labor and management requirements of the alternatives could be a deciding factor. Some operators might choose the alternative that appears to make the least change in their present program. Others might make the choice on the basis of least risk or on the least additional investment capital over and above the investment required for the irrigation system.

Because these "other considerations" can be important factors in making the final decision, doing a conscientious job of listing and evaluating them is important. However, assuming that the overall reason for being in business is to show a profit, most operators when adopting a change, are interested in making the change which has the greatest potential for increasing profits.

The potential value of a tool is only realized with proper use. Partial budgeting is a tool. It requires careful consideration of the economic and physical consequences of a change to particular situations for its full value to be realized. Keep in mind that the intent is to provide a tool—not an answer. That's up to you. Use the blanks.

As an incentive to use the tool, remember that "a change which appears to be a poor choice on paper can be easily discarded while a poor choice 'set in concrete' is expensive to rectify."