SOUTH CAROLINA IRRIGATION GUIDE

CHAPTER 9. IRRIGATION ECONOMIC EVALUATION

Contents

Tables

Exhibits-Cost and Return

SOUTH CAROLINA IRRIGATION GUIDE

CHAPTER 9. IRRIGATION ECONOMIC EVALUATION

GENERAL

The proper use of economic tools and procedures will provide cost and return information for alternative courses of action. With adequate economic data, an individual can make a reasonable decision as to the resource management system that best fits his requirements.

In advising farmers on the merits of one irrigation system versus another, or on the question of whether or not to invest in irrigation equipment, it must be remembered that in many instances, factors enter into the decision-making process that cannot be explained in a simple cost-return analysis. In some cases, such considerations as investment tax credit or other tax incentives may strongly influence the decision. If the farmer is financially secure, personal preference may guide his thinking. Another example is a situation where the grower considers an irrigation system to be justifiable in order to protect against the complete loss of a crop during an extremely dry season or for freeze protection but where the average annual benefit may not justify the purchase of a system.

If the farmstead is located in a remote area, an available irrigation system could be used to suppply water for fire suppression. Just the availability of a large, dependable supply of water could provide a sense of security for the farm family.

The above-mentioned reasons for, or advantages of, owning an irrigation system may at least complement the primary purpose for investing in the system which is to increase farm net income. Procedures outlined in this chapter should be useful in analyzing not only whether or not to irrigate, but which system would be most profitable.

DETERMINING IRRIGATION COST AND RETURN ON INVESTMENT

This chapter provides information and methods for determing how much an irrigation system will cost and how to estimate the return on investment. In the final analysis, comparison is made of the average annual cost of irrigating to the value of the estimated annual increase in production. This return on investment may be the deciding factor as to whether to invest in an irrigation system.

As an aid in better understanding the mechanics of calculating irrigation costs and returns, an example is presented and the steps are given for developing cost and return data for a typical irrigation system.

COMPILING INFORMATION NEEDED

To develope cost and return data for an irrigation system, certain information has to be obtained. Exhibit 9-1, General Information, can be used to compile information. The information entered in Exhibit 9-1 will be used as the example in the following sections.

General Information

	Item	Information Needed
1.	Crop(s) to be irrigated	Corn
2.	Expected increase in yield per acre from irrigation	75 bu
3.	Value of crop per unit (pounds, bushels, tons, etc.)	$3.00/bu
4.	Maximum soil water- intake-rate	2.6 in/hr
5.	Seasonal consumptive use of the crop	21 in
6.	Peak-use rate of the crop	0.33 in/day
7.	Number of hours to operate per day	22
8.	Minimum days required for each irrigation	2.7
9.	Number of irrigations expected per season	9
10.	Number of hours operation per year	486
11.	Shape and dimensions of field	2640' x 2640'
12.	Number of acres in field	160
13.	Type of system	Center-Pivot
14.	Number of acres to be irrigated	126
15.	Pumping rate needed in gpm	1200
16.	Source of water	Well
17.	Total height water is to be lifted	55'
18.	Total operating head	170'
19.	Size of power unit needed	100 bhp
20.	Type of power unit	Diesel
21.	Interest rate	15%
22.	Stand-by charges for electricity	Not Applicable
23.	Hours labor per acre per irrigation	0.05

Exhibit 9-1 General Information

INITIAL COST

When purchasing an irrigation system, one of the first things needed in determining cost and return of an irrigation investment is an estimate of the initial cost. This information is needed to: (1) help decide whether to pay cash for the system or finance it, and, (2) determine the annual ownership cost, which is a part of the total cost of owning, operating, and maintaining a system.

Just because an irrigation system would be profitable for a particular farm does not mean that the buyer can afford to finance it. An irrigation system may last 15 to 20 years, but many lending agencies require that they be paid for in 6 to 10 years. If this is the situation, the landowner may find himself with an annual payment that is more than the value of the expected increase in yield per year as a result of installing the irrigation system. For example, if $25,000 is borrowed to buy a system, at 15% interest for 10 years, then the annual loan payment would be $4,981 ($25,000 x 0.19925). If the expected value of the increased yield is $3,500, then the loan payments must be supplemented with additional money other than that expected from irrigating.

DETERMINING THE ANNUAL OWNERSHIP COST

The annual ownership cost is determined from the: (1) initial cost minus trade-in value of the system, (2) interest, (3) taxes and insurance, (4) fixed charges, (5) loss of income from land taken out of production for water development and (6) life expectancy of the system. Exhibit 9-2 should be completed as shown below to obtain the annual ownership cost for the system.

1. Enter in Column 2 the initial cost of the items applicable to the system and their trade-in value in Column 3. Enter in Column 4 the initial cost minus the trade-in value (Column 2 - Column 3).

2. Find the appropriate amortization factors from Table 9-1 for applicable items and enter in Column 6.

3. Compute the annual ownership cost for each item by multiplying the initial cost minus trade-in value by the appropriate amortization factor (Column 4 x Column 6) and entering in Column 7.

4. Estimate annual cost of taxes and insurance and enter it in space provided. This is estimated to be 1% of the initial cost.

5. Find the stand-by charges for electricity and enter in space provided. No electricity is being used in this example. If electricity is being used, stand-by charges can be obtained from the power supplier.

Initial and Annual Ownership Cost

Item (1)	Initial Cost (2)	Trade-in Value (3)	Initial Cost Minus Trade-in Value (4)	Expected Years of Life (5)	Amorti-1/ zation Factor (6)	Annual Ownership Cost (7)
WELL CASING						
Plastic	12,000	0	12,000	25+	.15470	1,856.40
RESERVOIR						
PUMPS						
Line Shaft Propeller				10		
Turbine	8,500	0	8,500	15	.17102	1,453.67
Centrifugal				12		
POWER UNIT						
Electric				25		
Gasoline				10		
Diesel	8,000	2,000	6,000	12	.18448	1,106.88
Natural Gas, LPG, OR Propane				10		
LAND DRAINAGE				20		
LAND LEVELING				15		
WATER PIPE						
Underground Pipe						
Plastic	9,000	0	9,000	25+	.15470	1,392.30
Aboveground Pipe						
Aluminum				15		
Galv. Steel						
PIPE TRAILER				10		
SPRINKLER SYSTEMS						
Hand-Moved				15		
Center-Pivot	60,000	15,000	45,000	10	.19925	8,966.25
Big Gun				12		
Permanent (Solid-Set)				20		
SUBIRR. SYSTEMS						
Ditches				25		
Pipelines				20		
Structures						
MISCELLANEOUS						

Total Initial Cost 97,500

Taxes and Insurance (Total Cost x .01) = $97,500 x 0.01 = 975.00

Stand-By (Fixed Charges) for Electricity = -

Loss of Income Due to Acreage out of Production ($ - /Acre x - Acres) = -

Total Annual Ownership Cost(Column 7) = $15,750.50

1/ 15% Interest Rate Used (Factors from Table 9-1)

Exhibit 9-2. Initial and Annual Ownership Cost

6. Determine a value for the loss of production from the land taken out of production. For this example, no loss is involved since a well supplies the water and uses a negligible amount of land. If a pond, lake, or reservoir is the water source, the value of any loss of production from the former use of the land should be considered.

7. Find the total annual ownership cost by adding the figures in Column 7 and enter in space provided.

Table 9-1. Amortization 1/ Factors

Expected No. of Years of Life	10%	11%	12%	13%	14%	15%	16%	17%
2	.57619	.58393	.59170	.59948	.60729	.61512	.62296	.63083
4	.31547	.32233	.32923	.33619	.34320	.35027	.35738	.36453
6	.22961	.23638	.24323	.25015	.25716	.26424	.27139	.27861
8	.18744	.19432	.20130	.20839	.21557	.22285	.23022	.23769
10	.16275	.16980	.17698	.18429	.19171	.19925	.20690	.21466
12	.14676	.15403	.16144	.16899	.17667	.18448	.19241	.20047
15	.13147	.13907	.14682	.15474	.16281	.17102	.17936	.18782
20	.11746	.12558	.13388	.14235	.15099	.15976	.16867	.17769
25	.11017	.11874	.12750	.13643	.14550	.15470	.16401	.17342

1/ Amortization - Used to convert installation costs into equal annual payments.

DETERMINING THE ANNUAL OPERATION AND MAINTENANCE COST

The annual operation and maintenance cost is determined from the annual expense of operating the system. This includes (1) fuel, (2) oil, (3) repair and maintenance of equipment, (4) reservoir and field maintenance, (5) additional seed, fertilizer, pesticides, and harvesting cost for the increase in yield, and (6) labor.

Annual Operation and Maintenance Costs shown in Exhibit 9-3 may be completed as shown below to obtain the annual operation and maintenance cost.

1. Find the total annual cost of fuel. Table 9-2 gives the brake horsepower hours per unit of fuel. Record the values needed from Exhibit 9-1 and Table 9-2 and follow the mathematical instructions given for Item 1. Using $1.20 per gallon for diesel fuel, the total fuel cost is $4,000.00.

Annual Operation and Maintenance Cost

Item	Horse power Required		Number of Hours Operated		Cost Per Unit of Fuel		bhp Hours Per Unit of Fuel	Total
1. Fuel	100	X	486	X	$ 1.20	-	14.58	$4,000.00
2. Oil-Engine	100	X	486	X	$ 4.00	-	900	$ 216.00
3. Oil-Gear Drive	-	X	-	X	$ -	-	-	$ -
or Electric Motor	-	X		X	$ -		-	$
4. Repair and Maintenance (power unit)	100	X	486	X	$0.002	per bhp		$ 97.20
5. Repair and Maintenance	$97,500	initial cost X .005						$ 487.50
6. Reservoir and Field Maintenance	$ -	initial cost X .005						$ -
7.1/Additional Seed, Fertilizer, Chemicals, and Harvesting Cost (estimate)	$ 21.35	anticipated additional expense per acre X 126 (number acres)						$2,690.10
8. Labor	0.05 hours per acre per irrigation X 9 No. of irrigations X 126 acres X $4.00 per hour ----------							$ 226.80
9. Total Annual Operation and Maintenance Cost ----------								$7,717.60

1/ This value is the amount you expect to spend in addition to that which you would spend if you did not irrigate. It varies with the crop. For some crops, you may not have any additional expense.

Exhibit 9-3 Annual Operation and Maintenance Cost

Table 9-2 Annual Fuel Consumption

Fuel or Power	bhp-Hours per Unit of Fuel
Electric	1.18 per Kilowatthour
Gasoline	11.30 per gallon
Diesel	14.58 per gallon
Propane	9.20 per gallon
Natural Gas	88.93 per 1000 cubic feet

2. Find the total annual cost of oil. Table 9-3 gives the brake horsepower hours per gallon of oil. Record the values needed from Exhibit 9-1 and Table 9-3 and follow the mathematical instructions given for Item 2. Using $4.00 per gallon for oil, the total cost of oil is $216.00.

3. Find the total cost of gear oil. No cost was figured for gear oil in this example.

   If this cost is to be added, record the values needed from Exhibit 9-1 and Table 9-3 and follow the mathematical instructions given for Item 3.

4. Find the total annual cost of maintenance of the power unit. Table 9-4 gives the estimated cost of power unit repair and maintenance per brake horsepower per hour. Record the values needed from Exhibit 9-1 and Table 9-4 and follow the mathematical instructions given for Item 4. Total for this example is $97.20.

5. Find the total annual cost of repair and maintenance of the irrigation equipment. The cost used for repair maintenance of the irrigation equipment was estimated at 0.5% of the initial cost. The initial cost of the equipment is obtained from Exhibit 9-2. The total for this example is 0.005 x $97,500 = $487.50.

6. Find the total annual cost of reservoir and field maintenance. For this example, no cost was figured for reservoir and field maintenance.

   If reservoir or field maintenance is required for your irrigation system, obtain the initial cost of the equipment from Exhibit 9-2 and follow the mathematical instructions given for Item 6.

7. Estimate the total annual cost for the additional yield from irrigation by following the mathematical instructions for Item 7. If the farmer is expected to spend more for seed, fertilizer, pesticides, labor, handling or storage than he would without irrigating, estimate the cost. This will depend on his crop and the manner in which he has been farming. A figure of $21.35 per acre was used for this example.

8. Find the total annual cost of labor. Record the values needed from Exhibit 9-1 and follow the mathematical instructions given for item 8. In this example using $4.00 per hour for labor, the total cost is $226.80.

9. Find the total annual operation and maintenance cost. This is obtained by adding all items in the "Total" column. The total for this example is $7,717.60.

Table 9-3. Annual Oil Consumption (1982)

Type of Engine and Drive	bhp - Hours Per Gallon of Oil
Electric	9000
Gasoline	900
Diesel	900
Propane	1000
Natural Gas	1000
Right Angle Gear Drive	5000

Table 9-4. Annual Cost of Repair and Maintenance (1982)

Type of Power Unit	Cost Per bhp Per Hour
Electric motor and controls	$ 0
Gasoline	$ .0017
Diesel	$ .0020
Propane	$ .0013
Natural Gas	$ .0013

DETERMINING THE RETURN ON INVESTMENT

The primary purpose for estimating the total annual cost of an irrigation system is to have a figure with which to compare the value of the expected increase in production from using that system. To obtain the return on investment, Exhibit 9-4 "Return on Investment" should be completed as shown below.

1. Determine the value of the expected increase from irrigation per acre. Record the expected yield increase and value from Exhibit 9-1 and follow the mathematical instructions on Exhibit 9-4. In this example the total value of the increase in yield is $225.00 per acre.

2. Find the total annual cost per acre for irrigating. Add the total annual ownership cost from Exhibit 9-2 to the total annual operation and maintenance cost from Exhibit 9-3 and divide by the number of acres. The total in this example is $186.25 per acre.

3. Find the expected return on investment per acre from irrigating with this system. This is obtained by subtracting the total annual cost of irrigating from the value of the expected increase. The total expected return on investment per acre for this example is $38.75.

Return on Investment

1. Value per acre of expected increase from irrigation:

   75 bu yield/acre (Exhibit 9-1) x $3.00/bu (Exhibit 9-1) = $225.00

2. Total annual cost per acre of irrigation:

   $15,750.50 (annual depreciation cost - Exhibit 9-2)

   + $ 7,717.60 (annual operating cost - Exhibit 9-3)

   Total = $\frac{\$23,468.10}{126}$ number of acres (Exhibit 9-1) = $186.25

3. Expected Return per acre on Investment = $225.00 - $186.25 = $38.75

Exhibit 9-4. Return on Investment

Using the assumptions and data contained in the above example, the following analysis can be made as to the price and yield required to "break-even" (The point where the additional income due to irrigation equals the cost of irrigation):

Break-even Price for 75 bu increase = $2.48/bu

$$\left(\frac{\$186.25 \text{ Increase in Cost}}{75 \text{ bu}} \right)$$

Break-even Yield for $3.00/bu corn = 62 bu/ac

$$\left(\frac{\$186.25 \text{ Increase in Cost}}{\$3.00/\text{bu}} \right)$$

Break-even Yield for 2.00/bu corn = 93 bu/ac

$$\left(\frac{\$186.25 \text{ Increase in Cost}}{2.00/\text{bu}} \right)$$

NOTE: Source of format used for this section: Planning for an Irrigation System. This publication was developed by the American Association for Vocational Instructional Materials in cooperation with the Soil Conservation Service. Data in this section has been updated to approximately the 1982 to 1985 period.