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Costs of Sprinkler Irrigation On Idaho Farms

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SUMMARY

Cost and operation records were taken on 61 sprinkler systems throughout Idaho during 1948 and 1949. The systems studied were about one-third of those in the state at the beginning of the 1949 irrigation season.

The purchase costs varied widely. On a per-acre basis the smaller systems were more expensive than the larger units. Sprinkler systems pumping from free-water sources were more expensive than those supplied by assessed-water sources. Systems for compact square and rectangular units were lower in price, and more elaborate designs increased the purchase cost considerably. The cheapest system was on a 64-acre unit and cost $28.31 per acre. The most expensive system was on a 45-acre unit and cost $222.22 per acre. The average cost for all systems studied was $82.90 per acre.

The annual cost of sprinkler irrigation includes depreciation, interest on investment, water, repairs and maintenance, power, and labor.

The farmer's estimate for the length of life of his sprinkler ranged from 10 to 40 years and averaged 15. The average estimated annual cost of depreciation is 1/15 of the purchase price.

The interest rate for money to finance sprinkler systems ranged from 3 to 8 percent and averaged 5 percent. The average annual cost for interest is computed as 5 percent of ½ the purchase price.

The annual cost for water on supplies which were assessed ranged from $.77 to $7.10 per acre and average $3.55. The higher annual depreciation and interest costs and the higher power bill on systems supplied by free-water sources offset the cost of water for assessed-water systems.

The yearly expense for repairs and maintenance ranged from 0 to 2.3 percent of the purchase price and averaged .4 percent. This figure may increase as the systems get older.

The cost for power ranged from .57 to 4.27 cents per kwhr and averaged 1 cent. This unit cost is lowest for systems operating the most hours per month. Each electric power distributor has a separate power rate so that power costs vary from distributor to distributor. The power bill is higher for crops requiring more water. The additional pumping head for using free-water sources required more electricity.

The labor required for applying water by sprinkling ranged from .3 to 1.8 man hours per acre per irrigation and averaged .9 man hours. Crops requiring more irrigations had a correspondingly higher annual labor cost.

The annual cost for small systems was much higher than for larger systems.

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Costs of Sprinkler Irrigation on Idaho Farms

By

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IN 1948 the Idaho Agricultural Experiment Station, cooperating with the Farmers Home Administration, kept detailed records on cost and operation of 17 sprinkler irrigation systems throughout Idaho. At the end of the irrigation season it was considered necessary to expand the study to obtain a larger sample. In 1949 the study was enlarged to include 61 systems. The 1948 records available on the additional 44 systems were added to the study and complete records were taken on all systems in 1949. Table 1 shows the size and location of the systems and some representative data taken.

All of the systems were of the semi-portable, conventional-move type. The sample comprised about one-third of the systems in operation in the state at the beginning of the 1949 irrigation season. There were 391 systems listed in the census taken during the early months of 1950.

How the Idaho Farmer Can Use This Information

This study was directed at the question, "Will sprinklers pay?". Each farmer must answer this question for his own farm by weighing the costs against the returns. This publication shows the items to consider in determining sprinkler costs. It also provides average costs to use as a guide. The farmer's own cost figures for his own set-up, rather than the average, are his best guide as costs for each sprinkler system are above or below the average figure.

PURCHASE COSTS

A wide variation appeared in the per-acre purchase cost for the 61 systems studied. This variation indicated that each farm was a separate problem of design. The cheapest system was a 64-acre sprinkler unit which cost $28.31 per acre. The most expensive was a 45-acre system costing $222.22 per acre. The average of all systems studied was $82.90 per acre. Basic reasons for the cost spread were the size of the system, source of water supply, shape of the layout, and elaborateness of the layout.

Table 1. The Cost, Location, and Some Features of the Sprinkler Systems Studied.

Farm Unit No.	Location	Purchase Cost	Size Sprinkler System in Acres	No. of Sprinkler Heads	Capacity (GPM)	Total Pumping Head (Feet)	Power Supply	Motor HP.	Water Source[1]
1	Post Falls	$1556.00	20.0	16	120	70	electric	5	assessed
2	Post Falls	1634.00	40.0	16	220	81	electric	10	assessed
3	Post Falls	1585.00	34.0	16	140	71	electric	5	assessed
4	Post Falls	2137.00	40.0	32	250	76	electric	7½	assessed
5	Coeur d'Alene	2225.00	40.0	32	256	74	electric	10	assessed
6	Coeur d'Alene	3504.00	50.0	16	240	70	electric	10	assessed
7	Coeur d'Alene	1954.80	52.0	18	200	81	electric	7½	assessed
8	Coeur d'Alene	4436.00	80.0	32	425	116	electric	15	assessed
9	Post Falls	2196.00	30.0	16	120	76	electric	5	assessed
10	Post Falls	1075.00	10.0	16	80	95	electric	3	assessed
11	Coeur d'Alene	1480.00	30.0	16	115	100	electric	5	assessed
12	Post Falls	1065.00	20.0	16	80	90	electric	3	assessed
13	Post Falls	1560.00	30.0	16	128	99	electric	5	assessed
14	Hayden Lake	4500.00	102.0	48	.....	....	electric	7½	assessed
15	Coeur d'Alene	3100.00	27.0	14	100	120	electric	5	well
16	Chilco	2000.00	35.0	24	192	....	gravity		creek
17	Hayden Lake	1985.00	30.0	26	144	74	electric	7½	lake
18	Post Falls	1380.00	19.75	16	220	105	electric	7½	assessed
19	Post Falls	1255.00	10.0	16	220	105	electric	7½	assessed
20	Lewiston	2000.00	21.0	16	.....	....	gravity		assessed
21	Lewiston	1520.00	27.5	16	.....	....	gravity		assessed
22	Lewiston	1628.49	16.5	14	120	96	electric	5	river
23	Lewiston	10,000.00	45.0	20	300	101	electric	20	river
24	Lewiston	1739.50	18.0	20	120	150	electric	7½	river
24A	Lewiston	15,040.00	120.0	100	.....	46	electric	30	river
25	Weiser	3243.00	26.0	30	250	100	electric	10	well
26	Weiser	4215.50	40.0	38	204	125	electric	15	well
27	Weiser	4785.00	80.0	30	160	150	electric	20	well
28	Weiser	1658.00	11.3	11	77	95	electric	5	well
29	Weiser	4100.00	60.0	45	292	85	electric	15	well
30	Weiser	1819.61	25.0	12	112	100	electric	5	well
31	Weiser	7500.00	89.0	36	400	120	electric	15	well
32	Weiser	2871.06	20.0	19	160	120	electric	7½	well

Table 1. The Cost, Location, and Some Features of the Sprinkler Systems Studied. (Continued)

Farm Unit No.	Location	Purchase Cost	Size Sprinkler System in Acres	No. of Sprinkler Heads	Capacity (GPM)	Total Pumping Head (Feet)	Power Supply	Motor HP.	Water Source[1]
33	Weiser	3700.00	58.0	48	450	140	electric	20	well
33A	Weiser	13,000.00	102.0	55	440	225	electric	50	slough
34	Emmett	2600.00	20.0	52	130	100	gravity		assessed
35	Emmett	2200.00	21.0	18	.....	....	electric	15	assessed
36	Emmett	620.00	5.5	20	.....	....	gasoline		assessed
37	Emmett	1500.00	20.0	33	120	115	electric	5	assessed
38	Emmett	5633.00	55.0	90	250	88	electric	10	assessed
39	Payette	1649.00	22.0	16	112	125	electric	5	pond
40	Parma	1420.00	8.0	30	210	70	gasoline	9	assessed
41	Payette	3099.00	21.0	29	165	103	electric	7½	assessed
42	Payette	2008.00	10.0	24	168	....	electric	10	river
43	Payette	1800.00	19.5	9	63	95	electric	5	assessed
44	Payette	3624.00	47.0	52	468	160	electric	20	assessed
45	Fruitland	15,350.00	240.0	200	1000	140	electric	50	assessed
46	Fruitland	4113.00	60.0	40	270	90	electric	15	assessed
47	Payette	3350.00	40.0	32	190	140	electric	10	assessed
48	Payette	9120.00	150.0	132	870	100	electric	30	assessed
49	Caldwell	3008.00	60.0	32	350	170	electric	20	assessed
50	Caldwell	5236.00	37.0	55	265	170	electric	20	well
51	Caldwell	7050.00	80.0	64	.....	....	electric	30	well
54	Nampa	4856.40	77.0	65	400	135	electric	20	assessed
55	Caldwell	5740.00	28.7	26	146	177	electric	15	well
56	American Falls	1173.00	8.0	15	150	92	electric	5	drain
57	American Falls	5000.00	56.0	35	300	115	gasoline	30	river
58	American Falls	6660.00	38.0	32	256	155	butane	65	well
59	Westmond	1049.00	10.0	8	80	99	electric	5	lake
60	Sagle	1812.00	64.0	18	135	92	electric	5	river
61	Wendell	7720.00	80.0	66	660	116	electric	30	well

[1] Assessed water was delivered to the sprinkler irrigation pump through surface ditches from canal company sources.

Size of System

Table 2 shows that smaller systems cost more per acre than larger systems. This comparative relationship between the cost per acre and the size of the system is also shown in Figure 1.

Table 2. The average purchase cost per acre by size of system. Idaho, 1948-49.

Acres Sprinkled	Number of Farms	Average Purchase Price Per Acre
0 to 24	21	$106.60
25 to 49	20	94.60
50 and over	20	73.60
All farms	61	82.90

Source of Water Supply

Of the sprinkler systems studied, 33 took water from surface ditches served by canal companies, and 28 pumped water from such cost-free sources as wells, rivers, and ponds. In general, the free-

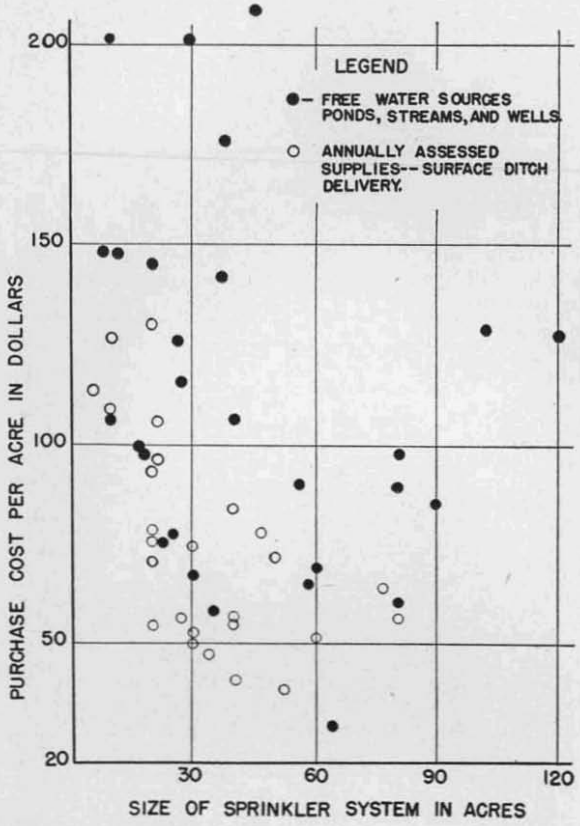

Figure 1. The relationship between the purchase cost per acre and the size of the sprinkler system. The systems using water from free-water sources were more expensive than those supplied with assessed water.

water-source systems were more expensive due to additional equipment necessary to take advantage of the free water. They averaged $103.10 per acre; the assessed water systems averaged only $66.20 per acre. This relationship can be noted in Figure 1.

Shape of Layout

Figure 2 is a representative comparison of purchase price and sprinkler system layout for two farms in the study. System 26 lifted water 12 feet to reach field level. System 4 pumped from field elevation. Pumps for both were the same make and type and system 4 was 20 percent larger in capacity. The sprinkler systems are the same make and both are designed to irrigate 40 acres. The basic difference is the hape of the layout. The system for the compact square farm cost only $53.43 per acre; the similar system for the oddly shaped farm cost $105.37 per acre. Sprinkler systems serving compact square or rectangular areas were lowest in purchase cost.

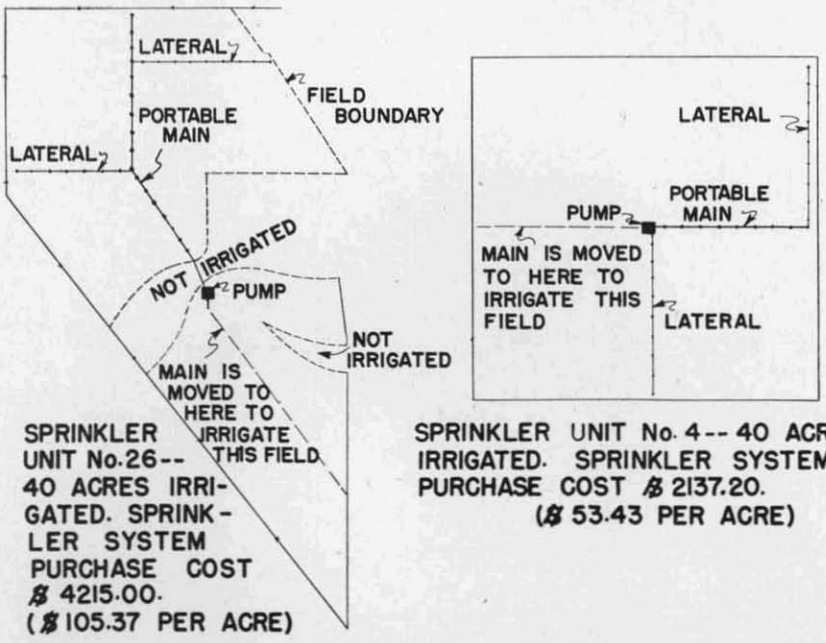

Figure 2. A typical comparison of the purchase cost for sprinkler equipment in relation to the shape of the sprinkler system layout. Systems for compact square or rectangular irrigated areas were lowest in purchase cost.

Elaborateness of Layout

Some operators use more expensively designed sprinkler systems to decrease labor costs or to facilitate operation. Figure 3 shows the sprinkler system for unit No. 4 as purchased and the estimates for adding additional equipment to it. Increasing the main line would eliminate moving the main for each irrigation. Adding the stand-by laterals allows each lateral to remain in place during the set following irrigation. Laterals are then moved after the crop foliage and ground surface have dried off. Adding equipment beyond the minimum requirement raises the purchase price considerably.

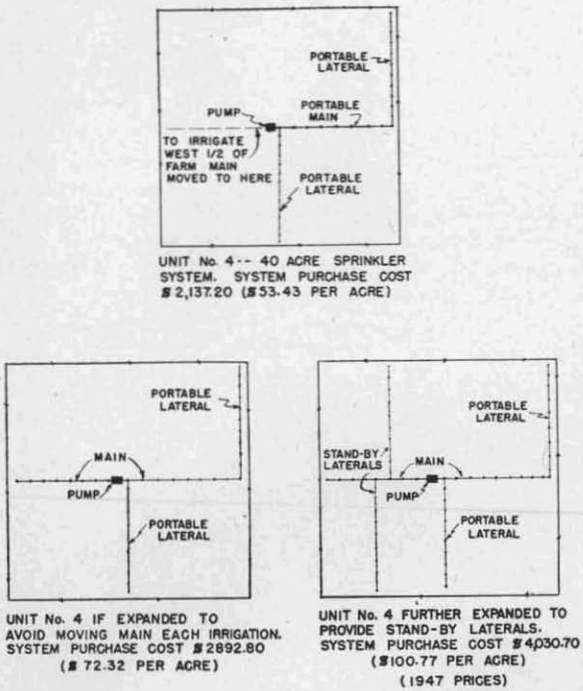

Figure 3. The relationship between purchase cost and the elaborateness of the sprinkler system layout. The purchase cost increases rapidly as additional equipment is added beyond the minimum requirement.

ANNUAL COSTS

The annual cost is all of the costs attributed to each year's operation of the system. It includes (1) depreciation, (2) interest on the investment, (3) water, (4) repairs and maintenance, (5) power, and (6) labor. The purchase price is accounted for in the annual cost by depreciation and interest on the investment. Normally taxes are one of the costs included. There were no tax assessments against the systems studied. Therefore this item is not included in the annual cost. Table 3 shows the annual average costs found and the range of these costs.

Depreciation (averaged 1/15 of purchase price)

The purchase price is spread over the years of use as depreciation. The farmer's estimate of life for his sprinkler system ranged from 10 to 40 years and averaged 15. As the systems were all purchased since 1945, none have worn out and actual data on depreciation is not available.

Table 3. Average Annual Costs for Sprinkler Irrigation. Idaho, 1948-49[1]

Cost Item	Average	Range	Average Annual Cost per Acre	
			Free-Water Source	Assessed-Water Source
Depreciation[2]	1/15 purchase price	1/10 to 1/40	$ 6.90	$ 4.40
Interest[3] **on** investment	5% of ½ purchase price	3% to 8%	2.60	1.65
Water				
Assessed	$3.55 per acre	$ .77 to $7.10		3.55
Free	0	0	0	
Repairs and **Maintenance**	0.4% of purchase price	0 to 2.3%	.40	.25
Power	1 cent per kwhr	.57 to 4.27	3.75	3.10
Labor	.9 man hours per acre each irrigation[4]	.3 to 1.8	5.30	5.25
	Average Total Annual Cost		$18.95	$18.20

[1] Averages are rounded to the nearest significant figure.
[2] Depreciation was computed by taking 1/15 the average systems' cost.
[3] Interest was computed by taking 5% of ½ the average systems' cost.
[4] Using 75 cents as an hourly labor charge.

Interest On Investment (averaged 5 percent of ½ of purchase price)

In some instances the farmer borrowed money to buy a sprinkler system; in others he used his own. In either case, the charge for the use of the money is a part of the annual cost.

As the sprinkler system is used, it decreases in value. When the system is worn out its value is considered to be zero. The average value over its life's span will be half way between the new value

and the worn out value, or half the purchase price. The annual cost of interest will then be interest at the going rate on half the purchase price.

The interest rate paid for financing sprinkler systems ranged from 3 to 8 percent. The average interest rate was 4.8, or approximately 5 percent.

Water (assessed supplies averaged $3.55 per acre)

Water supplied by organized groups was assessed to meet the expenses of the organization. The annual assessment for this type of water supply ranged from $.77 to $7.10 per acre, and averaged $3.55 per acre. Those who used water from a free-water source, such as well or pond, did not have this expense.

Repairs and Maintenance (averaged .4 percent of purchase price)

The annual cost for repairs and maintenance during the 2 years of study was approximately 0.4 percent of the purchase price. All the systems in the study were purchased since 1945. Older systems might show a higher cost for this item.

Power (averaged 1 cent per kilowatthour (kwhr)

The study showed the sprinkler systems powered with electricity to average 1 hp. for each 3 acres on free-water supplies and 1 hp. for each 4.4 acres for assessed sources. The electric power cost ranged from .57 to 4.27 cents per kwhr. The average cost was .9 cent, or approximately 1 cent per kwhr.

There was a large variation in the power cost per acre from operator to operator. The fundamental reasons for variation were: hours of operation per month, the power distributor, the crop irrigated, and the total pumping head.

Hours of Operation per month:

As shown in Table 4 and Figure 4 the cost per kwhr changed with the number of hours operation per month of the sprinkler system. The lowest rates were paid by the systems operating the greatest number of hours each month.

Table 4. A typical comparison of the cost per kwhr with the average hours of operation each month.

(Data from 1948 records from one power company).

Unit No.	kw demand of system	Months of operation	Average hours operated each month	Average cost per kwhr in cents
54	15	5	318	.90
35	15	5	294	.98
49	15	6	246	1.1
50	15	3	101	1.7

Power distributor:

Each electric power distributor has its separate power rate for irrigation pumping. Pumps for sprinkler systems are billed according to this rate. Figure 4 shows the cost per kwhr for pumping according to the rates of two distributors in Idaho. Only four systems in the study were powered by internal-combustion engines.

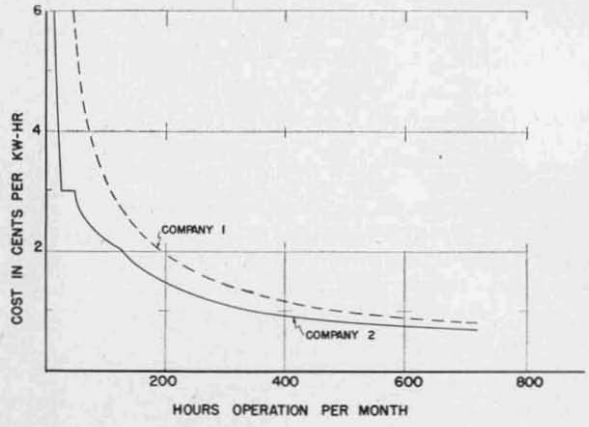

Figure 4. The relationship between the cost per kilowatt hour and the number of hours of operation per month for an 8 kilowatt pumping unit of approximately 10 hp. Figures are according to the power rates of two power companies operating in Idaho.

Crop irrigated:

Table 5 shows the difference in water requirements of Idaho crops irrigated by sprinkler in 1949. Crops requiring more water have a higher water bill. There was no significant difference between the water applied to a given crop in northern Idaho and southwestern Idaho. There was also no significant difference between the irrigations per crop in the two areas.

Table 5. Average number of sprinkler irrigations and amount of water applied to Idaho crops in 1949.

Crop	No. of Irrigations	Inches of Water Applied
Grain	3	9
Corn	4	12
Beans	6	16
Alfalfa	7	22
Pasture	8	26
Beets	11	29
Red Clover	11	32

Total pumping head:

The water from free-water sources had to be lifted to reach the elevation of the field; assessed water was generally available at field level. As the result, the power bill was greater for free-water systems, averaging $3.75 per acre as against an average of $3.10 per acre for systems supplied by assessed water.

The pressures at field level varied from system to system. The variation ranged from 20 pounds per square inch to approximately 60 pounds per square inch (46 ft. head to 138 ft. head). The higher pressures required more electricity for the additional pumping head.

Labor (averaged .9 man hours per acre per irrigation)

In determining the labor requirement, all labor associated with handling and operating the sprinkler equipment was included. The labor for applying water with a sprinkler system ranged from .3 to 1.8 man hours per acre per irrigation and averaged .9 man hours. With the exception of orchards, there was no general difference in this requirement from crop to crop. Orchards were high with an average requirement of 1.4 man hours.

Figure 5 shows the average labor used in sprinkler irrigation for several crops common in the study. The average annual labor requirement increased directly with the number of irrigations applied.

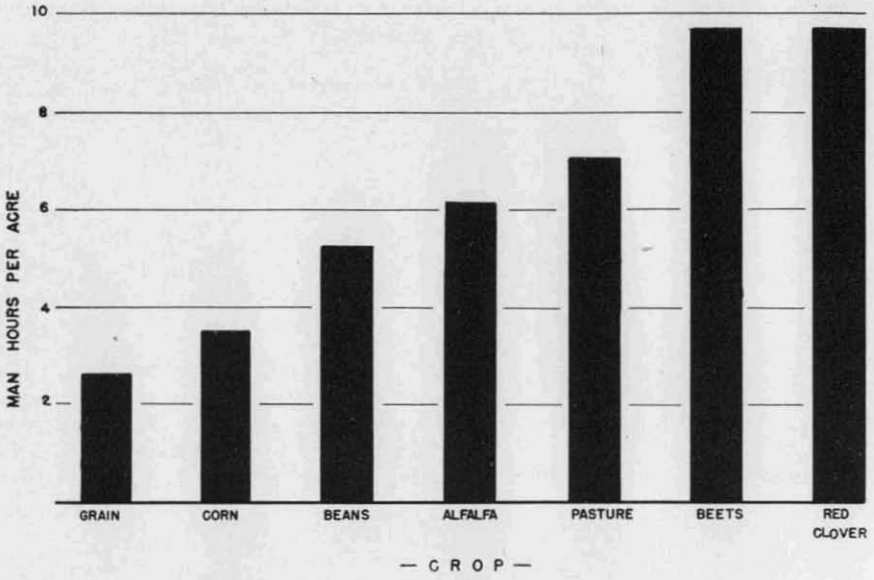

Figure 5. The average labor requirement by crop for sprinkler irrigation in Idaho. The average annual labor requirement increased directly with the number of irrigations applied to the crop.

COMMENTS ON ANNUAL COSTS

The annual cost for a sprinkler system will vary as its individual costs vary. For example, those who pay more for water will have a higher per acre cost than those whose water assessment is less. Similarly, the computed cost for depreciation would be much less if the farmer estimated his system would last 30 years instead of 15.

A very important influence is the size of the area sprinkled as this size affects several of the individual costs making up the annual cost. As the area sprinkled increased, the annual per acre cost decreased. Table 6 shows that the annual cost decreases from $28.63 per acre for the farms sprinkling less than 25 acres, to $16.09 per acre for the farm sprinkling 50 acres and over.

Table 6. The effect of size of area sprinkled on average annual costs per acre. Idaho, 1948-49.

Item of Cost	Size of Area Sprinkled			
No. of farm years	0 - 24 acres 36	25 - 49 acres 36	50 acres & over 33	All Farms 105
Depreciation	$ 8.11	$ 5.94	$ 5.05	$ 5.67
Interest	2.76	2.09	1.65	1.90
Water	2.51	2.34	1.76	2.03
Power	5.21	3.40	2.82	3.17
Repair and Maintenance	.82	.22	.21	.29
Labor	9.22	4.98	4.60	5.27
Total	$28.63	$18.97	$16.09	$18.33

Little difference was found in the average annual cost (see table 2) for free water and assessed water systems. Systems obtaining water from free sources had higher costs for depreciation, interest, and power which offset there being no cost for water.

Acknowledgment

The authors express their appreciation to the Idaho farmers who provided detailed records of their sprinkler system operation and their crop returns for this study and to the Farmers Home Administration and county agents who worked with the farmers in obtaining the necessary records. Power companies and cooperatives supplied valuable information on power used and its costs during the two years over which the records were kept.

Much of the data used in preparing this publication was gathered by Bruce Brooks, formerly Research Fellow in the Department of Agricultural Economics. A considerable part of the evaluation of data is taken from Brooks' thesis entitled "The Cost of Sprinkler Irrigation in Idaho" presented in 1950.