Capital Needs and Requirements For Irrigation in South-Central Kansas

by

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CAPITAL NEEDS AND REQUIREMENTS FOR IRRIGATION IN SOUTH CENTRAL KANSAS

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CHAPTER I

INTRODUCTION

A major goal of the commercial farmer in South-Central Kansas is to maximize income from crop farming. The use of capital, including investment in irrigation, is a tool that may permit him to increase net returns to his resource inputs. Nelson and Murray indicate the importance of funds--one form of capital--in farming as follows:

> Capital for acquiring production assets is essential for success. The amount of capital a farm family controls, the terms and conditions under which it is used determine, in large degree, the level of income. 1/

The objectives of this study are: (1) to estimate costs of irrigation development in South-Central Kansas, (2) to estimate cash flow and returns on investment from irrigation projects in the study area and (3) to explore available means of financing irrigation projects by individual farmers. Various irrigation systems will be examined with data from several sources, including data from selected farms in Farm Management Association No. 2 in South-Central Kansas. From these data a study will be made of possible orderly payback of investments in irrigation development. Alternative sources of investment funds for irrigation development will be evaluated.

Farm Management Association farms are productive commercial farms managed by above average operators. Farms in the Kansas Farm

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1/ Aaron G. Nelson and William G. Murray, Agriculture Finance, 5th ed., Iowa State University, Ames, Iowa, 1967, p. 3.

Management Association had an average gross income in 1969 of $49,092; while the average Kansas farm grossed $23,077. 2/ In 1969 about 3.75 percent of all farms in the state belonged to the Farm Management Association. For this reason, the study is a demonstration of what is being done by operators of farms that are above average in quantity and perhaps quality of resource inputs and in annual gross receipts per farm. Capital managed by association farms has been growing over time, as has acres farmed and current-dollar owner equity. However, the ten year trend in percentage of owner equity has been downward slightly as more borrowed capital is used in the farm business. Although of growing importance, non-farm income is a small part of the total income of association farms. Statistical characteristics of farms in Farm Management Association No. 2 are shown in tables 1 and 2.

2/ Farm Facts 1969-1970, Kansas State Board of Agriculture, Topeka, Kansas, p. 86F.

TABLE I.--AVERAGE ANNUAL GROSS INCOME BY SOURCE AND ITEMIZED EXPENSES PER FARM IN KANSAS FARM MANAGEMENT ASSOCIATION NO. 2, 1968 AND 1969.[a]

	1969 Average of All 406 Farms	1968 Average of All 415 Farms
INCOME		
Cattle	10,197	8,771
Hogs	2,865	2,061
Sheep	1,338	1,174
Horses & Poultry	386	389
Dairy Products	4,694	4,330
TOTAL LIVESTOCK INCOME	19,480	16,727
Crops and Supplies	14,851	13,547
Inventory Change-Crops & Supplies	2,098	757
Miscellaneous Receipts	6,919	6,336
GROSS FARM INCOME	43,348	37,369
FARM OPERATING EXPENSE		
Feed bought	5,661	5,626
Hired labor	2,022	1,674
Fuel and oil	1,565	1,398
Auto expense	483	442
Machinery repairs	2,692	2,233
Trucking & machine hire	1,375	1,169
Vet. & livestock expense	1,218	995
Fet. & annual lime expense	2,694	2,882
Seed & crop expense	1,793	1,347
Tele. & elec. expense	446	400
Farm org. fees, etc.	274	235
Taxes, cash rent, int., ins.	5,431	4,777
Repairs on perm. improv.	293	261
TOTAL CASH OPERATING EXPENSE	25,927	23,435
Depr. of machinery	4,090	3,522
Depr. of bldgs. & improv.	466	408
TOTAL FARM EXPENSE	30,483	27,366
NET FARM INCOME	12,865	10,003
Net work, capital @ 6%	2,015	1,823
Net fixed capital @ 6%	3,113	1,814
TOTAL INTEREST	5,128	3,637
OPR'S RETURN FOR LABOR & MGT.	7,737	6,365

[a]1969 Farm Management Association No. 2 Summary, Kansas State University.

TABLE 2.--AVERAGE RESOURCE USE PER FARM

KANSAS FARM MANAGEMENT ASSOCIATION NO. 2

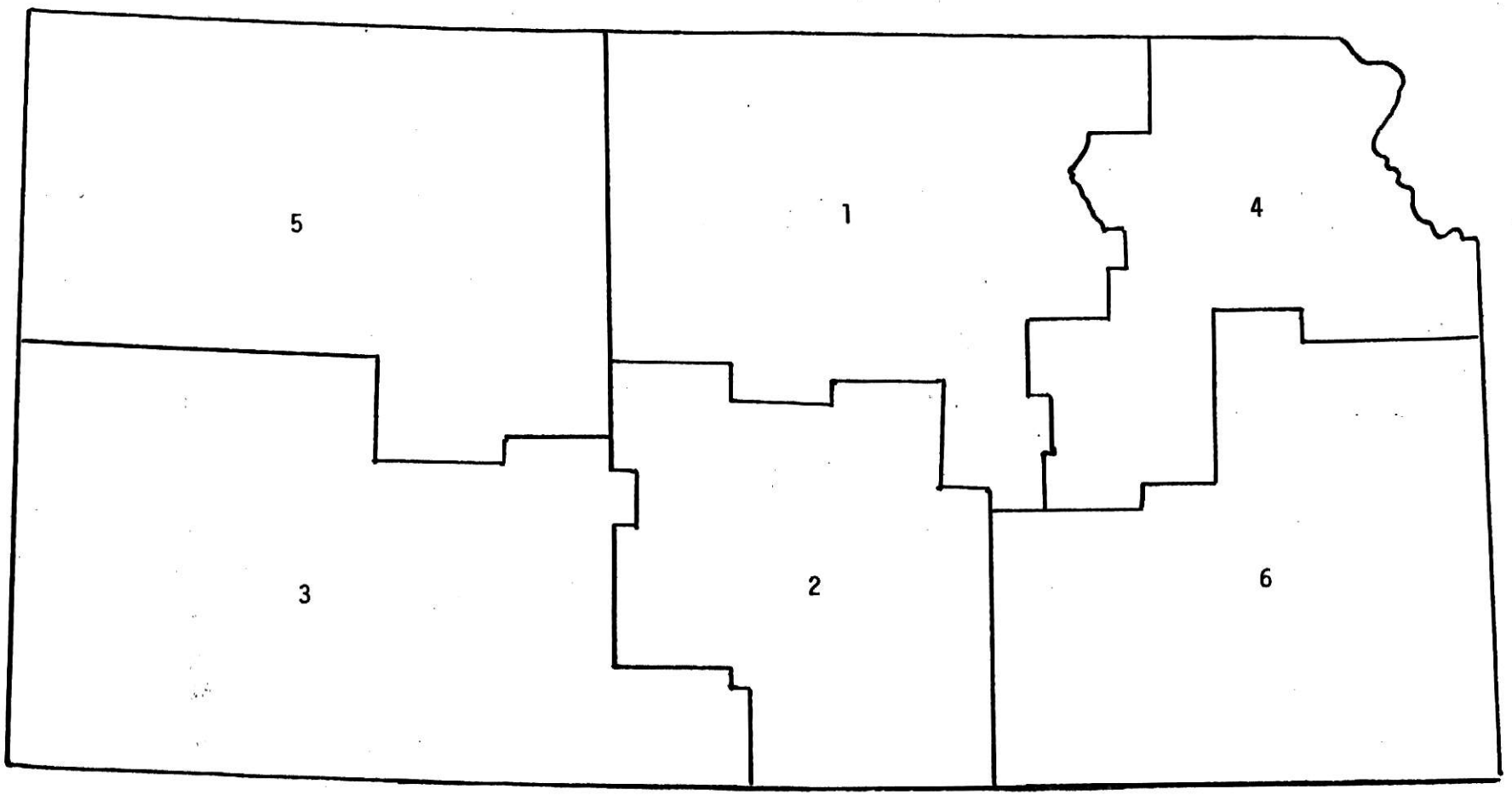
1968 and 1969[a]

	1969 Average of All 406 Farms		1968 Average of All 415 Farms	
SIZE: Working Capital	53,972		49,165	
Real Estate	190,768		178,893	
Total investment managed	244,740		228,058	
Gross farm income	43,348		37,369	
	Own	Rent	Own	Rent
Total acres	334	592	308	577
Crop acres	237	442	213	441
Man work days		*464*		449
LABOR				
Number of men		1.5		1.5
Investment managed per man		158,350		149,800
Gross income per man		28,046		24,546
Total acres per man		599		675
Crop acres per man		439		430
Man work days per man		300		295
MACHINERY				
Total investment		16,556		14,345
Investment per crop acres		24.37		21.90
Machinery cost per crop acres		13.73		12.34
LIVESTOCK	No.	Prod.	No.	Prod.
Beef cows & % calf crop	8	87.2	10	92.4
No. litters & pigs weaned	2	7.2	3	7.3
Ewes & % lamb crop	16	98.5	24	99.1
Dairy cows & dairy rec./cow	7	601.57	7	570.07
Laying hens & egg rec./hen	8	3.23	51	5.43
CROPS				
	Own	Rent	Own	Rent
Acres in grass	-	-	48	62
CROP PRODUCTION	Acres	Yield	Acres	Yield
Wheat	338	33.5	370	34.1
Corn	8	67.9	4	98.6
Grain Sorghum	95	57.7	89	46.9
Barley	--	----	8	49.6
Soybeans	10	22.5	8	20.3
Alfalfa Hay	32	3.0	31	2.4
All Silage	26	14.5	23	10.5
GROSS VALUE OF CROPS/CROP ACRE	48.36		45.79	
FERTILIZER COST PER CROP ACRE	3.95		4.40	
CROP COSTS PER CROP ACRE	25.41		23.33	
TOTAL FARM EXP./$100 GROSS	70.32		73.23	

[a]1969 Farm Management Association No. 2 Summary, Kansas State University

Figure 1.

KANSAS MANAGEMENT ASSOCIATIONS



A. EXISTING IRRIGATION IN THE STUDY AREA

The area outlined on the Kansas map (Figure 1) shows an eleven-county area designated as Kansas Management Association No. 2. The study area has good ground water supply for irrigation and recharge condition which suggests a long irrigation life. Irrigation has generally been profitable. Prospects are favorable for continued profitability, even though the yield difference between dryland and irrigated farming is not as great as it is in the Southwestern Kansas area as reported by Amar Sirohi. 3/

Irrigation minimizes the weather risk of inadequate moisture. It greatly increases the investment per acre, but increases and stabilizes crop production. 4/ Early irrigation in the South-Central Kansas area was established as insurance against a dry year. With high development costs and thus high investment, later units have been established with plans to supplement rainfall moisture every year.

Average annual rainfall in the area, over a 15 year period, varied from 21.04 inches in Harper county on the west side of the area to 32.04 inches in Sumner county on the east. For fall planted crops such as wheat, the normal expected rainfall is 19 inches on the west

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3/ Amar Singh Sirohi, An Economic Analysis of Irrigation in Western Kansas, a dissertation. Kansas State University, Manhattan, Kansas, 1962.

4/ J. H. McCoy, O. H. Buller, Frank Orazem and Wilton Thomas, How to Determine Relative Profitability of Selected Enterprises On Irrigated Western Kansas Land, Kansas State University Experiment Station, Report of Progress, July 1966, page 1.

side of the area to 22 inches on the east side of the area during the growing season. Growers of spring and summer crops such as sorghum, corn, and alfalfa, can normally expect 12.25 to 14.75 inches during its growing season. Rainfall has varied from 9.86 inches to 31.70 inches for fall crops and from 5.63 inches to 26.32 inches for spring and summer crops. This points out the need for the use of irrigation to help stabilize variable moisture and in turn overcome one of the chief limiting factors to maximum crop production.

There is a 92% chance of getting less than four inches of rainfall in the August 9-23 period in McPherson county. Summer crops need four inches of moisture in this period for optimum growing conditions. There is an 83.5% probability of getting less than two inches of rainfall in any given year from May 31 to June 7. Two inches is the peak optimum need in McPherson county for fall crops. 5/ & 6/ Stored soil moisture some years will supply the optimum levels needed by the growing crops. If moisture had been in short supply in earlier months and was not in soil storage, dryland crops would suffer.

Geologically, South-Central Kansas seems to be in a good position to take advantage of continued expansion of irrigation. According to The Kansas Water Resources Board, the South-Central Kansas area is more fortunate than the extreme west with its relative shortage with

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5/ Climate in Kansas, State Board of Agriculture, Topeka, Kansas, 1948.

6/ L. Dean Bark, Chances For Precipitation In Kansas, Kansas State University Experiment Station, Manhattan, Kansas, Bulletin 461, May 1963, p. 73.

respect to water supply, because of the favorable recharge characteristics of the aquifers. "The problems which are likely to arise in South-Central Kansas with an increase in irrigation are those of poor water quality and poor drainage." 7/

Zimmerman said:

> "The development of an area (for irrigation) should be in step with the capability for its efficient exploitation. Overly ambitious development and consequent planting, especially in areas where farmers have little experience with irrigated farming, inevitably will plunge the farmer into problems he will not be able to solve in time and may ruin him." 8/

For orderly and efficient development, therefore, it will take considerable time for evaluation and development between initial plans and the realization of a completed irrigation project. Realization of farm income from irrigation investment takes additional time. In contrast, the community begins to feel the effect in new jobs almost as soon as the plan begins to develop.

The economic value of irrigation development is reflected in land values, as reported by Lee in a Southwest Kansas study in 1968. "It is revealed that for many of the cases included, the value of water is roughly $40 per acre plus three cents per gallon per minute of well capacity." 9/ Value contributed by irrigation water may be greater in

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7/ Irrigation in Kansas, Water Resources Board, Topeka, Kansas. Report No. 1661, September, 1967.

8/ Joseph O. Zimmerman, Irrigation, John Wiley and Sons, Inc., New York, London, and Sydney, 1966, p. 6.

9/ Sam Lee, "The Effect of Underground Water On Land Value in Southwestern Kansas", Kansas Farm Business Information Newsletter, Kansas State University Extension Economics, Manhattan, Kansas, June 5, 1968, p. 1.

Southwestern Kansas than in South-Central Kansas because of larger annual and seasonal variations in rainfall in the Southwestern area. Nevertheless, it has been observed that irrigation water potential and development are significant price factors in open land sales in South-Central Kansas. Increased asset value in the community provides additional collateral by which funds may be attracted for further community economic growth and development.

Historically, the first record of irrigation by early settlers in Kansas, is reported as follows: "George Allman, Wallace county, had irrigated his farm for 18 years (beginning in 1877). When government troops were at Fort Wallace he furnished them with vegetables."10/

On August 7, 1893, an "irrigationists meeting at Great Bend resolved that federal and state governments should provide irrigation systems in arid regions."11/ On September 22, 1894, "the Barton County Irrigation Company began a canal to irrigate 200 acres of bottom land on the Arkansas River at Great Bend."12/ Ground water from wells didn't become a large source of water supply for irrigation until recent years. In 1948, there was 4,400 acres being irrigated in the eleven counties in the study area. In twenty years, 1968, this had grown to 80,000 acres. Nearly 50,000 acres is sprinkler irrigation.

10/ Annuals of Kansas, Kansas State Historical Society, Topeka, Kansas, Volume 1, 1886-1890, p. 194.

11/ Ibid, p. 155.

12/ Ibid, p. 184.

Irrigation acreage in the United States has grown 28 percent from 1959 to 1967. In 1967 there were 44,000,000 acres irrigated in the United States with 7,000,000 acres of this being done by sprinklers.13/ Irrigation acreage in Kansas has grown from 221,199 acres in 1948 to 1,588,377 acres in 1968. Irrigation in South-Central Kansas has grown from 1.99 percent of the Kansas total in 1948 to 5.02 percent in 1968.14/

Of the total acres irrigated in Kansas, 16 percent is sprinkler irrigation which is equal to the national percentage. Of the total acres irrigated in Kansas, 36 percent is planted to grain sorghum, 25 percent to corn, 20 percent to wheat, 8 percent to forage sorghum and 5 percent to alfalfa.15/ The remaining 6 percent is pasture and speciality crops.

There were 709 farms using irrigation in the eleven South-Central Kansas counties of the study in 1968. Of these 70 or 10 percent were in Farm Management Association No. 2.16/

Table 3 compares the total acres and irrigated acres of each of the major crops harvested in the study area in 1968.

13/ Claude H. Pair, Sprinkler Irrigation, Third Edition, Sprinkler Irrigation Association, 1000 Vermont Ave., N. W., Suite 711, Washington, D. C. 20005, 1969, p. 2.

14/ Kansas County Extension Agents Annual Reports, Manhattan, Kansas, 1968.

15/ Russell L. Herpich, "Underground Pipelines For Irrigation", Engineering Newsletter, Kansas State University Extension Engineering Service, Manhattan, Kansas, June 1970, p. 1.

16/ Kansas Farm Management Summary and Analysis Report For 1969, Department of Economics, Cooperative Extension Service, Kansas State University, Manhattan, Kansas, 1969.

TABLE 3.--TOTAL ACRES AND IRRIGATED ACRES HARVESTED, BY CROP, BY COUNTY

FOR THE STUDY AREA, 1968

COUNTY	ALL WHEAT	IRR. WHEAT	ALL GRAIN SORGHUM	IRR. GRAIN SORGHUM	SILAGE SORGHUM	IRR. FORAGE SORGHUM SILAGE	CORN SILAGE	ALL CORN GRAIN	IRR. CORN-ALL	IRR. PASTURE
Barton	208,000	1000	28,000	4,400	50,000	2,500	2,650	600	1,400	100
Harper	203,000	1000	6,000	400	30,000	110	200	400	250	---
Harvey	104,000	----	59,000	-----	30,000	400	4,500	1,400	1,700	---
Kingman	188,000	----	28,000	-----	46,000	370	1,350	200	120	---
McPherson	197,000	----	60,000	2,000	58,000	1,000	2,250	3,300	3,500	---
Pratt	161,000	1000	36,000	1,700	36,000	4,880	2,350	1,000	3,400	---
Reno	303,000	1000	68,000	2,000	116,000	300	1,200	200	300	---
Rice	159,000	----	69,000	1,400	66,000	1,760	560	1,900	1,345	---
Sedgwick	195,000	----	64,000	900	30,000	90	1,700	5,500	1,180	60
Stafford	155,000	2000	46,000	8,500	59,000	4,620	400	300	1,200	200
Sumner	347,000	----	23,000	700	92,000	40	1,950	200	25	---
TOTAL	2,225,000 [a]	6000 [a]	486,000 [a]	22,000 [a]	613,000 [a]	16,070 [b]	[a]	[a]	14,420 [b]	360 [b]

[a] 1968 County Agent Reports
[b] 1969 Farm Facts, State Board of Agriculture

B. PHYSICAL POTENTIAL FOR IRRIGATION IN THE STUDY AREA

In the eleven-county area of this study there are 5,292,368 acres of agricultural land. Of this, 2,302,110 acres have a water potential of 500 gallons per minute per well. According to the State Water Resources Board, 65,130,000 acre feet of water is in the water bearing strata in the eleven counties. Table 4 shows the estimated irrigation potential.

The supply of water is an important consideration in irrigation development, but other factors cannot be ignored even on a large capacity well. Two of the factors that need to be reviewed are the application method and soil type. Table 5 is helpful in determining the expected water efficiency depending upon soil and application method. In South-Central Kansas where the evaporation rates are not as great normally as in western Kansas, we could possibly adjust these percentages upward. Sprinkler systems where the nozzles are properly designed should allow efficiencies of as high as 84 percent.17/

17/ Loc. cit., Sprinkler Irrigation, p. 126.

TABLE 4.--ESTIMATED IRRIGATION EFFICIENCIES FOR WESTERN KANSAS[a]

Type of Irrigation System	Type of Soil: Clay-loam soil %	Average soil (Silt Loam) %	Sandy-loam soil %
Open Ditches	65.0	62.5	56.0
Both (gated pipes and open ditches)	67.5	65.0	62.5

[a]Amar Suigh Sirohi, op. cit., p. 32.

NOTE: These efficiencies in calculating the inches of net irrigation are subject to the condition that depth of gross application of water does not exceed a limit such that inches of water stored in the soil do not exceed the water holding capacity of the soil of a depth equal to the root zone of the crop irrigated. Water applied over and above that limit will have a zero percent irrigation efficiency.

Another factor to consider is the water needed for the crops grown in the area to produce maximum output. Different crops use varying amounts of water. Different varieties of the same crop use varying amounts of water. Crop breeders have continued to develop better adapted varieties and hybirds for irrigation. In an early study in Akron, Colorado in 1914, it was found that for optimum production for the varieties of the period it took 505 pounds of water to produce one pound of wheat. It took 858 pounds of water to produce one pound of alfalfa. For corn it took 372 pounds of water and for sorghum 271 pounds of water to get one pound of product. The irrigation farmer should review experiment station tests to select the most suitable varieties of each crop for irrigation in his area.

The peak month water requirements for each county and commonly grown crop has been calculated. This is shown on table .

The Kansas Water Resources Board18/ has projected estimates on irrigated acreage in the state in 1980 and 2000. Estimates for the South-Central Kansas area were 166,700 acres by 1980 and 472,500 by 2000. In 1968 there were 80,000 acres; so, if estimates are correct, irrigated acreage will double in the next ten years and increase by nearly six times in 30 years.19/ Tables 5, 6, 7,8and 9 review these statistics by counties.

Water Resources Board estimates are that in Kansas by the year 2000, 62 percent of the total 14,200,000 acre feet of water used will be for agricultural purposes. (Table 11) Municipal and industrial use will increase (mostly instream) by a greater percentage than will agricultural use, according to the Water Resources Board's projections. Water use projections indicate that the state as a whole should have plenty of water. This is not to say that all communities will have adequate water supplies at all times. Shortages could occur in Sedgwick county and certain areas of Harvey and Reno counties in South-Central Kansas where urban demand is relatively heavy.

The natural recharge for the eleven counties in South-Central Kansas is very favorable. It is estimated at 1,550,400 acre inches annually. This is about three times the annual projected use for irrigation by the year 2000. Water supply is expected to be adequate for

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18/ Loc. cit., Irrigation In Kansas.

19/ See table for county breakdown of the acres estimated.

irrigation and for expected heavier urban use of water in the area. Table 10 gives a county breakdown on the estimated recharge.

The area has a large water resource that is relatively untapped. This water can be used profitably to help increase overall crop yields and in turn expand economic activity in agricultural production, transportation, processing and service sectors in the eleven county area of South-Central Kansas.

TABLE 5.--PEAK MONTH WATER NEEDS FOR THE ELEVEN COUNTY SOUTH-CENTRAL KANSAS AREA FOR COMMONLY GROWN CROPS[a] (Expressed In Inches)

COUNTY	ALFALFA AND SORGHUM	CORN	SOYBEANS AND PASTURE	WHEAT
Barton	8.0	6.75	6.25	4.75
Rice	7.3	6.8	6.2	4.5
Reno	8.7	6.2	7.6	4.8
Sedgwick	7.8	7.0	6.5	4.5
Stafford	7.8	7.0	6.6	5.0
Pratt	7.8	7.0	6.6	4.8
Harper	7.75	7.25	6.5	4.5
Harvey	7.6	7.0	6.5	4.5
McPherson	7.75	7.1	6.6	4.9
Kingman	7.5	7.0	6.5	4.75
Sumner	7.5	7.0	6.5	4.5

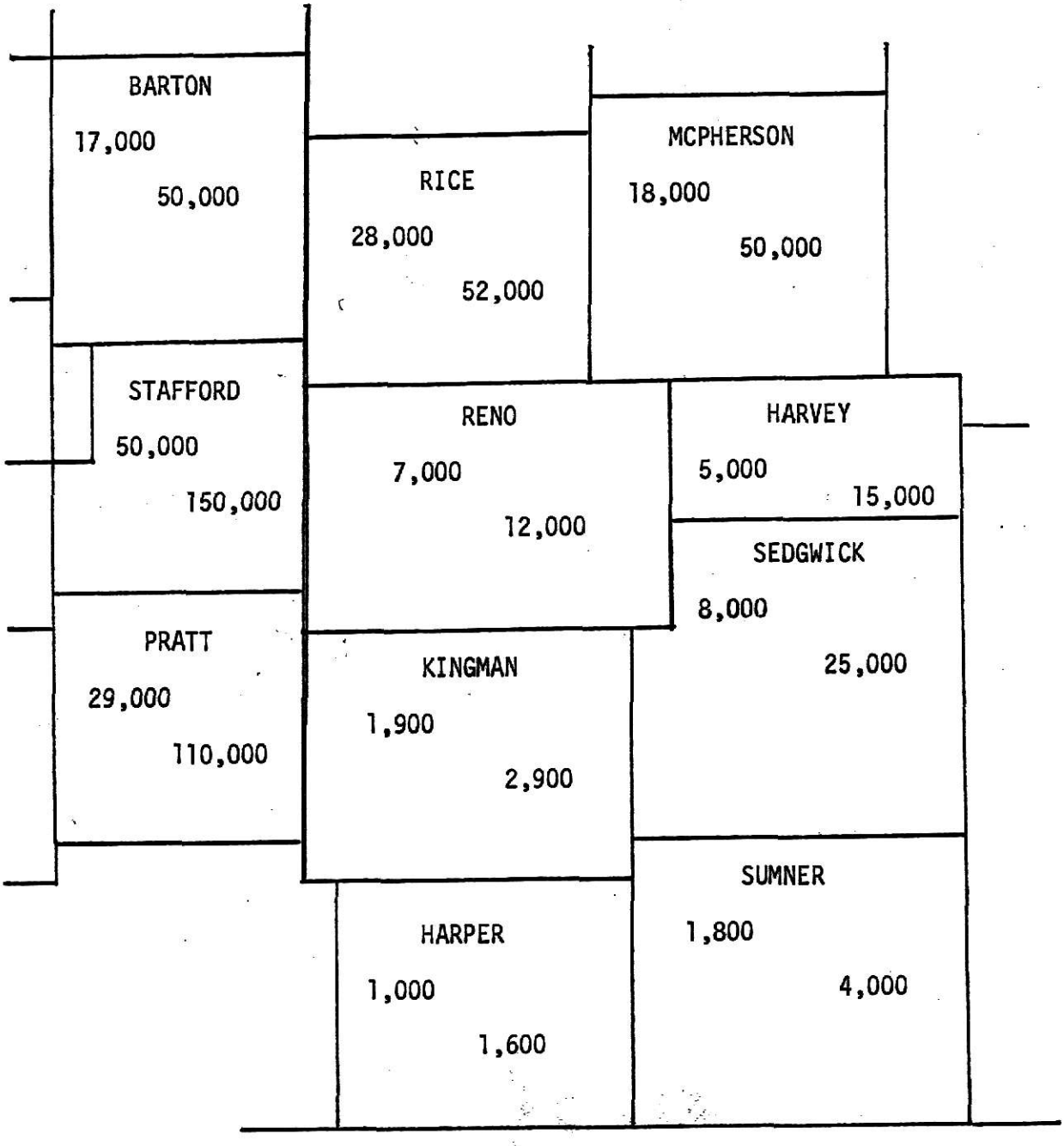
[a]Calculated for 90% of the time for optimum yields - taken from Irrigation In Kansas, Water Resources Board.

TABLE 6.--ESTIMATED IRRIGATION POTENTIAL[a]

COUNTY	AGRICULTURAL ACRES	LAND SUITABLE FOR IRRIGATION	EST. WELL WATER AVAILABLE (Million) Ac. Ft.	TOTAL LAND SUITABLE WITH WATER AVAILABLE 500 gal. per min. or more	100 gal. per min. to 500
Barton	520,444	438,144	4.74	193,270	28,264
Rice	433,984	418,710	4.14	131,613	8,087
Reno	752,406	643,402	13.27	422,113	75,321
Stafford	476,709	457,816	11.9	431,310	26,481
Sedgwick	86,883	191,719	5.9	86,883	191,719
Sumner	707,673	674,340	1.0	23,627	51,535
Harper	489,542	423,386	.85	128,303	120,830
Harvey	324,933	306,347	5.5	50,901	95,618
Kingman	524,229	460,167	3.1	355,990	6,819
Pratt	440,784	396,764	10.7	381,361	6,660
McPherson	534,781	454,516	4.03	96,739	128,200
Total Area	5,292,368	4,811,311	65.13	2,302,110	739,534
State	52,646,000	39,356,000		15,600,000	10,900,000

[a]Irrigation In Kansas, Water Resources Board.

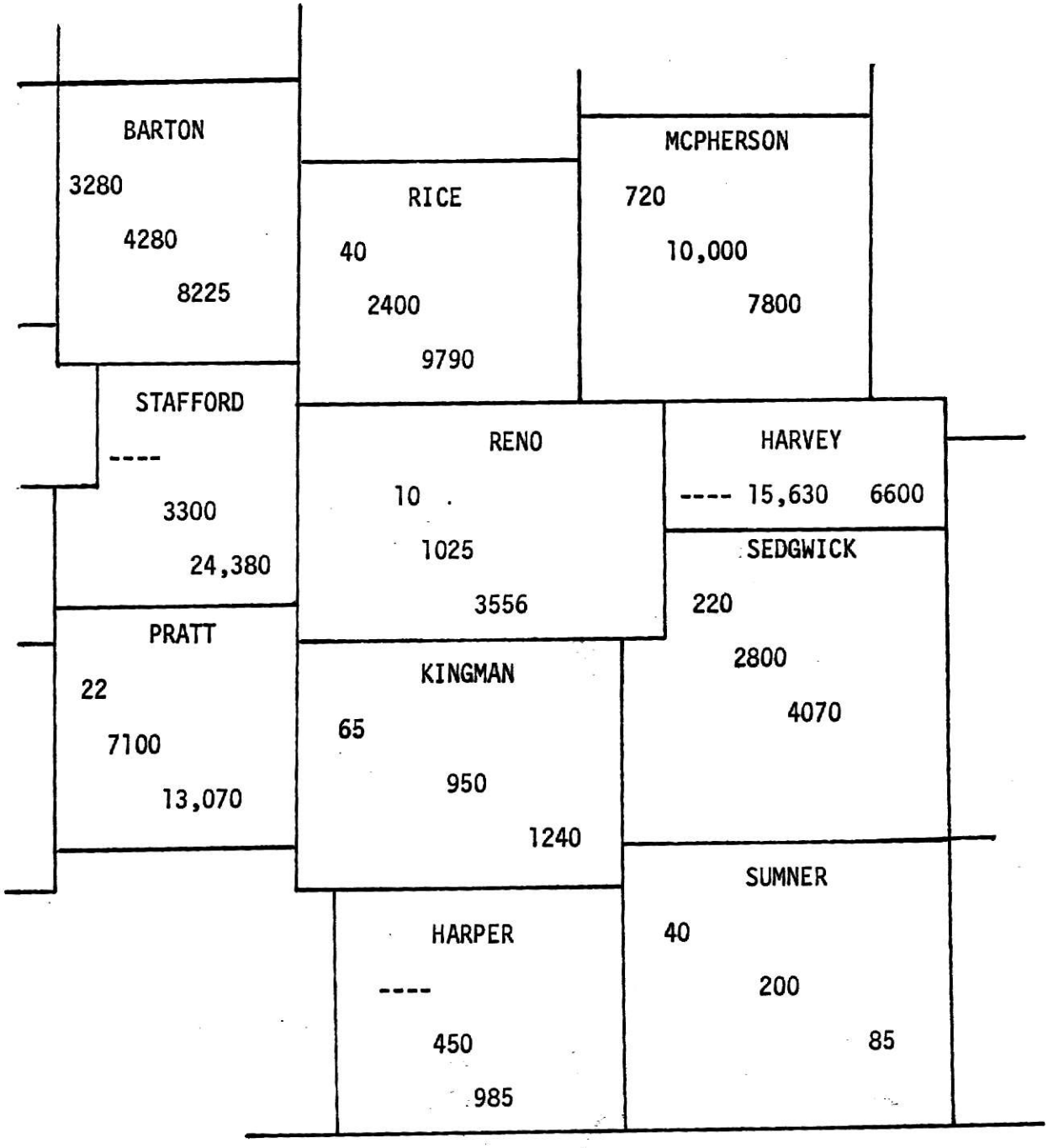
TABLE 7.--ESTIMATED IRRIGATED ACRES IN ELEVEN COUNTY AREA IN FUTURE YEARS[a]



First Number represents the 1980 figure. TOTAL: 166,700
Second Number represents the 2000 figure. TOTAL: 472,500

[a]From State Board of Water Resources, Irrigation in Kansas.

TABLE 8.--IRRIGATED ACRES BY YEARS

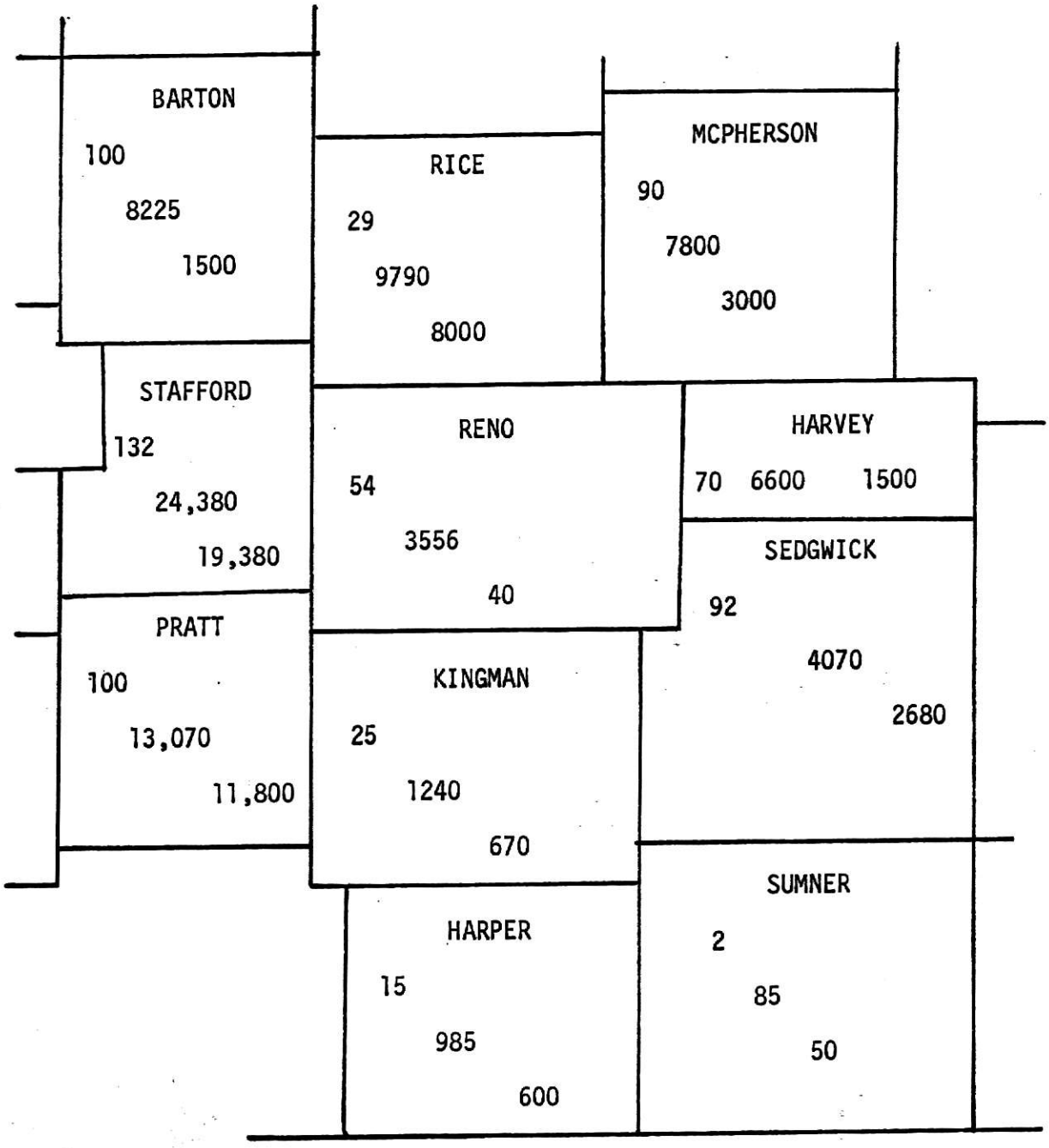


First Numbers - Represent 1948 figures. TOTAL: 4,397[a]
Second Numbers - Represent 1960 figures. TOTAL: 48,135[b]
Third Numbers - Represent 1968 figures. TOTAL: 79,801[b]

[a]1948 Figures from Survey by Walter Shelby, Extension Agriculture Engineer, Kansas State University.

[b]1960 and 1968 Figures from Kansas County Extension Agents Annual Reports.

TABLE 9.--USE OF IRRIGATION IN ELEVEN COUNTIES 1968[a]

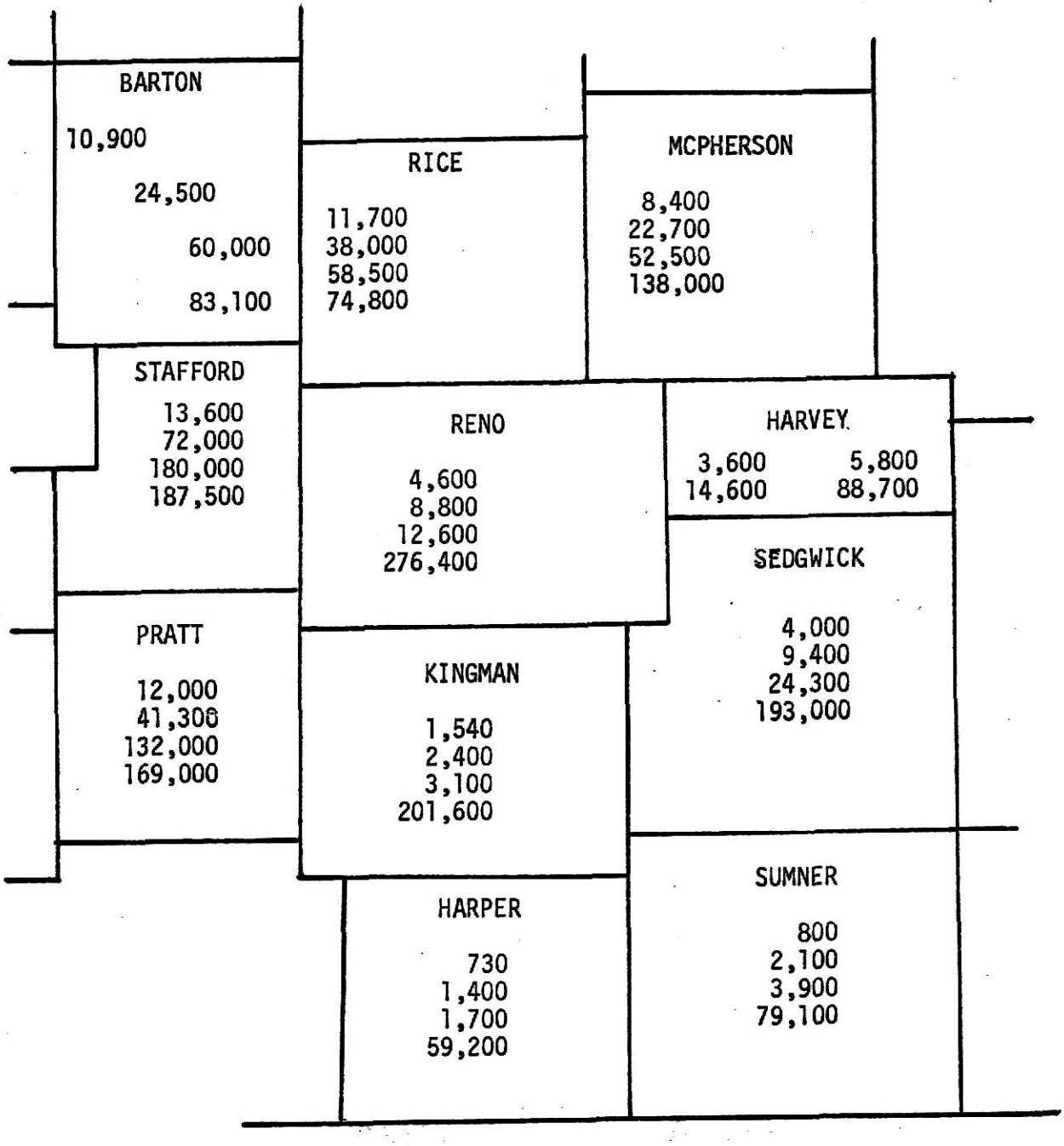


First Numbers - Represent Farmers Using Irrigation	TOTAL:	709
Second Numbers - Represent Total Irrigated Acres	TOTAL:	79,801
Third Numbers - Represent Sprinkler Irrigated Acres	TOTAL:	49,220

[a]1968 County Agents Reports.

TABLE 10.--ESTIMATED WATER USE

AND NATURAL WATER RECHARGE[a]



First Number represents the Use in 1966.	TOTAL: 71,870
Second Number represents the Estimated Use in 1980.	TOTAL: 194,200
Third Number represents the Estimated Use in 2000.	TOTAL: 543,200
Fourth Number represents the Estimated Recharge.	TOTAL:1,550,400

[a]State Water Resources Board, Irrigation in Kansas.

TABLE 11.--WITHDRAWAL DEMANDS FOR KANSAS

(MILLION ACRE-FEET)[a]

USE	1965			2000		
	SURFACE	GROUND	TOTAL	SURFACE	GROUND	TOTAL
Agriculture	.3	2.1	2.4	1.6	7.2	8.8
Municipal and Industrial	.8	.3	1.1	1.1	.8	1.9
Instream	---	---	---	3.5	---	3.5
TOTAL	1.1	2.4	3.5	6.2	8.0	14.2

[a]From Future Irrigation Water Demands - Impact of Technology and Management, Bulletin No. 11, State Water Resources Board.

C. ECONOMIC IMPACT OF IRRIGATION DEVELOPMENT

1. Impact On The Individual Farmer

In 1964, 65 percent of the farms in the state marketed products valued at $10,000 or less. In the 11 county area studied, a slightly lower percentage, 60.61 percent, (see table 12) of the farmers were in this low return group. With only average efficiency of 25¢ net per $1 gross, over 60 percent of the farms could not furnish an adequate family income without off-farm employment. In the absence of increased product prices, gross income from farming in the area can be increased only by farming more intensively with increased use of irrigation, fertilizer, livestock or other purchased inputs.

Higher product prices could occur as new and larger markets develop, but the trend has been for stable or falling product prices. The crops price index decreased from 222 to 220 from 1959 to 1969. At the same time the prices paid by farmers were going up at a rapid rate. It is generally expected to continue in this vein for the grain, forage, and poultry products that are common to this area. The farmers have thus turned to new technology and more intensive use of the land resource they have at present to increase their income. Irrigation is a logical step that may be available to the individual farmer to help boost income.

TABLE 12.--NUMBER AND PERCENT OF FARMS MARKETING UNDER $10,000 ANNUALLY BY COUNTY IN THE ELEVEN-COUNTY STUDY AREA, 1964[a]

COUNTY	TOTAL (Number)	UNDER $10,000 (Number)	(Percent)
Barton	1,218	915	75
Harper	936	494	53
Harvey	1,083	623	57
Kingman	1,057	623	59
McPherson	1,770	1,110	63
Pratt	672	384	57
Reno	2,100	1,293	62
Rice	854	455	53
Sedgwick	1,769	1,049	59
Stafford	737	411	56
Sumner	1,822	1,040	57
TOTAL	14,018	8,497	60

[a]1964 Agriculture Census

2. Impact On the Eleven-county Area

Increased average size of farm has also influenced total economic development in the area but has resulted in loss of population. Irrigation development may aid in holding population. In South-Central Kansas, the population of Stafford county decreased from 12,510 in 1910 to 6,791 in 1968. Pratt county, a more urban county with a larger trade center and heavier-traveled highway connections, has increased only slightly from a population of 11,156 in 1910 to 11,416 in 1968.20/ Both of these counties have been developing irrigation since early 1950, but Pratt county had more development at an earlier time. Irrigation benefits include development of supporting industries and increased employment in processing and equipment industries, fertilizer, insecticides, building construction and consumer goods businesses.

A Nebraska input-output study in 1963 found that $1 of increased income from irrigation caused an additional $5.68 of new business activity in the state. It consisted of $1.29 induced-by supplier activity and $4.39 stemming-from increased product processing and handling. Multiplier effects of irrigation ranked 11th out of 23 sectors studied. It had the greatest effect on real estate and labor sectors in comparison to dryland agriculture.21/

20/ Irrigation Influence in Southwest Kansas, Cooperative Extension Service, Kansas State University, Manhattan, Kansas, 1969, p. 6.

21/ T. W. Roesler, Charles F. Lamphear and M. David Beveridge, The Economic Impact of Irrigated Agriculture on The Economy Of Nebraska, Lincoln, Nebraska, Table C-3.

Skold made a similar study in the six northwest Kansas counties of Cheyenne, Rawlins, Sherman, Thomas, Wallace and Logan and three Colorado counties of Yuma, Kit Carson and Cheyenne.22/ All of these counties are considered rural with no large urban area involved. He found that annual retail sales alone, caused as a result of 17,187 acres of irrigation development in 1960-61, was $196,000 or over $11 per acre.

Net incomes increased $1,647,000 in the area studied by Skold in 1965 as a consequence of the $2,075,000 agricultural input for irrigation only. Irrigation farmers spend $23,000 additional on agricultural processing, which resulted in $9,000 net income increase to all local sectors. Goods and services purchases at retail by irrigation farmers in the amount of $1,469,000 resulted in $1,211,000 more net income to the area. Capital inputs purchased by farmers were $800,000 and resulted in $703,000 additional net income. The total effect of the $4,367,000 irrigation related spending by all sectors was $3,570,000 additional net income for 1965, that would not have been enjoyed under dryland farming. Of this $3,570,000 net income, the farmers' share was $1,048,000.

MuCullick made an input-output study in 1970 using mostly secondary data available from various United States government agencies and Kansas government agencies. This study used the Kansas Office Economic Analysis basic input-output study to determine the direct and

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22/ Melvin D. Skold, "What is Irrigation Worth", Irrigation Age, February 1969, p. 38.

indirect effects of irrigation on Southwest Kansas counties of Grant, Haskell, Stanton and Finney in 1965.23/

The increase in gross farm income directly attributable to irrigation over dryland farming in 1965, was $14,246,480. This amounted to an increase of $37.69 per acre irrigated over dryland conditions. The indirect effect of this additional output under the conditions McCullick assumed would add another $20,556,381 of economic activity in other sectors of the local economy. This amounts to $54.38 per acre of irrigation. McCullick points out that rainfall was six inches above normal in 1965, so a normal increase in income from irrigation would be even greater.

Irrigation acreage makes up 45 percent of the total harvested acres in the Southwest Kansas area. Agriculture is the major economic activity of the area. The study pointed out that if irrigation were to cease in the area, average annual income per person would drop by $477. The average personal income per resident in 1965 was $3,094. The sectors most dependent upon irrigation are: agricultural services, chemicals and allied products, and wholesale and retail trade.

Economic impact of irrigation will vary among areas and between time periods in which development occurs. However, in all cases secondary effects of investment and increases in primary income are substantial.

23/ Jack Joe McCullick, The Economic Impact of Irrigation on Selected Southwestern Kansas Counties: An Input-Output Approach. Doctoral Dissertation, Kansas State University, Manhattan, Kansas, 1970, p. 100.

D. IMPORTANCE OF CAPITAL TO AGRICULTURE DEVELOPMENT AND OPERATION

A commercial farmer manages a bundle of resources consisting of land, labor, and capital. In January 1970, the total assets of agriculture were valued at $311.4 billion and in early 1970 farm debt was $55.4 billion.24/ Debt in farming has risen steadily since 1946. In 1970, 82.21 percent of agricultural assets was classified as equity capital. In 1960, 87.8 percent was equity capital. It should be pointed out that total assets have increased also, but at a rate slower than debt.

Labor input in agriculture has dropped from 20 billion man hours per year in 1940 to about 8 billion today. As input mix changes, there is a growing need for new machinery, as well as capital improvements that must be amortized over the life span of the improvement.

Knight25/ studied the performance of 394 Central Kansas Farm Management Association farm records from 1960 to 1964. He related high earning power with capital items, particularly non-real estate or working capital categories. He found:

A. High returns to:
   1. Fertilizer
   2. Machinery
   3. Operating capital

24/ Agricultural Financial Review, U. S. Department of Agriculture, Washington, D. C., Vol. 31, December 1970, p. 1 and 2.

25/ Dale Knight, The Relation of Farm Size and Efficiency to Economic Outcomes on Central Kansas Farms, Kansas Agriculture Experiment Station, Kansas State University, Manhattan, Kansas, p. 24.

B. Moderate returns to:
   1. Livestock inventories
   2. Livestock expense items

C. Lower returns to:
   1. Real estate

A general trend to larger farms and greater specialization of farm production enterprises has increased capital requirements and created financial problems different from those of small diversified operations. The larger farms are less self-sufficient and must buy more of their inputs.

Farming will continue to use more capital in the future if present trends continue. This will be an outgrowth of adoption of new technology, relatively low capital costs compared with costs of land and labor, and continued pressures to expand individual farm units to achieve lower costs per unit of output.

Credit is non-equity capital. Credit should be used carefully and wisely by the farm operator to:

1. Create and maintain an adequate size business
2. Increase the efficiency of the farm business.
3. Adjust the business to changing economic conditions.
4. Meet seasonal and annual fluctuations in income and expenditures.
5. Assist in protecting the business against adverse situations.
6. Assist in providing continuity of a farm business.26/

If maximum profit is the goal, it will pay the borrower to use additional capital up to the point where its use just pays the cost (interest) of using the money. Risk, uncertainty and organizational

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26/ H. B. Howell, Agriculture Credit and The Farm Business, Iowa State University, Ames, Iowa, November 1967, p. 5.

limitations often stop application of capital to farming short of optimum. However, Brimmer points out that between 1956 and 1966 "on an average per farm basis, use of credit more than tripled, registering an annual rate of growth of 12 percent."27/ John Brake of Michigan State University has estimated that total farm debt will reach $100 billion 1980. He points out that the debt to asset ratio of 17 percent in 1965 is expected to reach 28 percent in 1980.28/ In manufacturing the debt to asset ratio is about 40 percent. The average Farm Management Association member in South-Central Kansas had a debt to asset ratio of 30.42 percent in 1969. Brake's estimates of investments in United States' agriculture are indicated in table 13.

Brakes' figures follow the balance sheet of agriculture general technique of including non-operating landlords equity with farm operators equity. In 1969 the United States Department of Agriculture made a special study of the equity of farm operators only. They found the debt to asset ratio for farm operators to be 13.9 to 100. This is a more comparable figure to the Farm Management Association farmers equity.

In his projections Brake considered many relevant factors, among

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27/ Andrew F. Brimmer, "Reorganization Due For Rural Banking", Agricultural Banking and Finance, Vol. 10, No. 1, January-February 1968, p. 21.

28/ John R. Brake, "Impact of Structural Changes on Capital and Credit Needs", Journal of Farm Management, Cornell University, Ithaca, New York, Vol. 48, No. 5, December 1960, p. 1541.

them an annual 3 percent increase in land values and an annual 4 percent decrease in quantity of land used in agriculture.

The National Advisory Commission on Food and Fiber reports expected increase in agricultural capital of 35 to 40 percent from 1965 to 1980. They expect capital requirements per farm to double, which is a somewhat more conservative view than that of Dr. Brake.29/ The commission's estimates are reported in table 14.

If these expectations are valid it is apparent that financing for irrigation development will be more dependent upon capital outside of agriculture. To obtain the capital outlay necessary to fulfill the requirements for development of 80,000 acres of irrigation in South-Central Kansas between 1968 and 1980, will require the individuals in the industry to be competitive with other sectors of the economy that are bidding for the investment dollars.

29/ Food and Fiber For The Future, Report of the National Advisory Commission on Food and Fiber, U. S. Government Printing Office, Washington, D. C., July 1967, p. 240.

TABLE 13.--A COMPARATIVE BALANCE SHEET FOR U. S. AGRICULTURE

1965 AND PROJECTED TO 1980[a]

Assets	Total (In Billion)		Average Per Farm	
	1965	1980	1965	1980
REAL ESTATE	$159.4	$249	$47,200	$119,400
NON REAL ESTATE				
Livestock	14.4	23	4,300	11,000
Machinery	25.2	36	7,500	17,300
Crops, stored	8.9	11	2,600	5,300
Household	8.8	9	2,600	4,300
Financial	21.1	24	6,200	11,500
TOTAL	237.8	352	70,400	168,800
CLAIMS				
Real Estate	18.9	59	5,600	28,300
Non Real Estate	18.6	41	5,500	19,700
TOTAL	37.5	100	11,100	48,000
OPERATOR EQUITY	200.3	252	59,300	120,800

(Number of Farms, 1965 = 3,380,000 and 1980 = 2,085,000)

[a]"Impact of Structural Changes on Capital and Credit Needs", Journal of Farm Management, Volume 48, No. 5.

TABLE 14.--CAPITAL PER FARM IN 1965 AND ESTIMATED CAPITAL PER FARM IN 1980[a]

Area	Per Farm Av. Capital Total		1980 Breakdown (In Thousands)		
	1965	1980	Land	Mach.	Livest.
United States	$63,000	$123,000	$ 94	$19	$10
Northern Plains	85,000	147,000	104	36	17

[a]*Food and Fiber For The Future*, U. S. Government Printing Office, p. 241.

CHAPTER II

REVIEW OF IRRIGATION COST AND RETURN INFORMATION

"Production is a process whereby some goods and services called inputs are transformed into other goods and service called outputs."30/ Production will generally take place in a free enterprise system only when the market indicates that a reasonable profit can be made. The delay in the time between a decision to produce and the actual harvest and the uncertainties involved may not allow a very clear analysis of the chances for a profit in irrigation farming. A farmer who has the high investment and relatively high annual fixed cost involved in irrigation will produce a crop even when the market price will not cover full costs. Examples of this have been observed in specialty crop production.

Most of the crops raised under irrigation in the eleven-county study area have active cash markets or can be fed to livestock on the producing farm. These markets are not always as favorable as desired by the producer nor indeed as favorable as he must have for a profit. The risk of losses may be reduced by diversification of production, insurance, contract, and flexibility of product use.

The first step to successful irrigation begins with planning. Inadequate planning and consequent under-estimation of development costs can be a source of serious financial difficulty for the developer. According to Zimmerman:

30/ C. E. Bishop and W. D. Toussaint, Agricultural Economics Analysis, John Wiley and Sons Inc., New York, New York, 1966, p. 29.

> If development is carried out by private investment, underestimation (of development costs) may mean ruin. Therefore, the planner should over-estimate both costs and development time. *The opposite practice has been the reason the* original developer is seldom the one who completes the project he has started.31/

The word 'seldom' in the above statement by Zimmerman is open to question in Kansas, but the rest of the quotation is often true. Development often does take more time and more money than first estimated without careful planning.

In small projects the cost has to be in direct relationship to the farmer's benefit; his crop returns will have to pay off all the investment.32/ A major objective of this paper is determination of the expected time in which the investment pay-off can take place and at the same time furnish the farmer a fair return for his labor and management and pay all production costs.

31/ Loc. cit., Zimmerman, p. 16.

32/ Ibid., p. 17.

A. STEPS TO DETERMINE THE GENERAL GEOLOGICAL AND PHYSICAL FEASIBILITY OF IRRIGATION

The first step in development is to determine the general *feasibility of irrigation through a preliminary investigation* for irrigation planning. Some of this data may be available for the asking if the developer knows where to obtain it. General information on (1) Hydrological and climatic investigation, (2) Water supply (quality and quantity), (3) Soil survey-fertility and drainage, (4) Topographical survey, is available from the local Soil Conservation Service of County Agricultural Extension Office.

The farmer must remember that "profitability of irrigation is affected by:

a. lift of water
b. kind of power used for pumping the water
c. acreage irrigated
d. kind of soil
e. use of nitrogen with irrigation
f. distribution of irrigation water over various periods of crop season."33/

These should be considered in his preliminary investigation.

The irrigation operating cost and efficiency depends upon a number of more technical factors generally subject to managerial control. They are "slope of land, length of the furrow, the presence of a dike

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33/ Loc. cit., Sirohi, p. 18.

at the lower end of the furrow, the initial and basic rate of application, the depth of application . . . the distance of the plot from the discharge head, the inches of moisture present in the soil just before irrigation."34/

> In the early stages, the planner should choose the most fertile land, and that which can be developed most easily. He should, if possible, avoid the steepest and flattest area, as well as the very light and very heavy soils. The best areas are those with light to medium textures deep soils on more or less even, graded land, with slopes between 0.3 to 3 percent running in well-defined directions.35/

Several cost increasing steps are necessary to insure the best well performance. The preliminary investigation should include drilling several test holes to insure a water supply, locating the static water level, and determining the character and thickness of the water-bearing formation.36/ This will help locate the well which may save costs of re-drilling or changing pipe. Casing with the correct sieve and wall thickness needed for the expected life of the well should be selected. Water quality can affect the type of casing needed since some water tends to eat the casing up over time.

A competent well driller that is familiar with the local water bearing strata should do the test well drilling. The Kansas Water Resources Board has many test wells in the state and much data to help supply information on water quantity and quality.

The correct gravel grade should be used in a reasonably uniform pack. This assures a porous cavity for the water to flood into the

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34/ Ibid., p. 31.

35/ Loc. cit., Zimmerman, p. 7.

36/ Ibid., p. 15.

casing from the water strata.

A newer but not necessarily less important trend in irrigation development is the addition of water control and drainage systems to channel, catch, and re-cycle extra water from the irrigation process. Tailwater pits at the low end of the field catch extra water and allow recharge or re-cycling of water. Re-cycling is usually the most economical water available if it is in large enough volume to use. "One of the quickest ways to get an operator to consider a tailwater recovery pit is for the neighbor to begin using the water as it leaves the land above."37/ Such a water conserving system may not be necessary in the early development stages, but it certainly should be considered soon after operation begins. If extensive land leveling and forming is needed in the beginning, it may be the most prudent move to design and develop the drainage system and catch pit at that time.

Use of underground pipelines offer several advantages among which are the following:

1. Buried pipelines offer minimum obstructions for planting, tillage and harvesting operations.
2. Weeds on field perimeters can be kept under control easily.
3. When properly installed, minimum maintance is required to keep the pipeline functioning properly.
4. Water can be conveyed over irregular topography.
5. Use of pipelines permits maximum control of water by the operator.

37/ Roger D. Hamilton, Irrigation, Garden City Community Junior College, Garden City, Kansas, 1970 section 4, p. 8.

6. Land formerly occupied by open ditches can be used to produce crops.

7. Pipelines eliminate losses formerly due to evaporation and seepage.

Table 15 is a suggested check list that the developer in South-Central Kansas may find useful in his preliminary investigation.

TABLE 15.--CHECKLIST FOR ORDERLY IRRIGATION DEVELOPMENT

STEPS	SOURCES OF ASSISTANCE	CHECK OFF AS COMPLETED	
1. Precipitation and climate patterns.	a. U. S. Weather Bureau b. State Climitalogist c. County Extension Office	_____	_____
2. Water supply in area	a. State Board of Water Resources b. Soil Conservation Service c. County Extension Office	_____	_____
3. Soil Survey (Fertility, Drainage, intake, etc.)	a. Soil Conservation Service b. County Extension Office	_____	_____
4. Topographical Survey	a. Soil Conservation Service	_____	_____
5. Equipment and Services	a. Directories b. Magazines & Newspapers c. Trade Shows	_____	_____
6. Test holes drilled	a. Competent local well driller	_____	_____
7. Economic Implications	a. Farm Management Association b. County Extension Agent c. Soil Conservation Service d. Credit Representives (FHA, Banks, PCA, Federal Land Banks, Insurance Comanies)		

B. ECONOMIC FEASIBILITY - COSTS

If a preliminary survey indicates irrigation potential in the farm the next step is to undertake a more precise study of the potential for profitable irrigation development.

For both flood and sprinkler systems, fixed investments are made up of well costs (wc), and land grading (gc). This can be presented as the development cost formula, Dc = wc + gc. The annual recovery of costs (dc) over the life of the system can be expressed as:

$$dc = \frac{(Dc - la)}{cy}$$

la = land value appreciation due to shaping the land and proof of water supply.

cy = expected years of life of the well and underground pipe.38/

1. Development Costs

Three sources of information on irrigation development costs will be reviewed. These are: (a) Irrigation costs as reported by Whipps for Southwestern Kansas in Economics of Irrigation, Kansas State University, Cooperative Extension Service publication MF-238, (b) Irrigation costs as reported by South Dakota economists in Irrigation Costs and Returns, South Dakota Extension Circular 680, and (c) Records from Harvey County, Kansas Irrigation Demonstration farms cooperating in studies by Kansas State University Agricultural Engineers.

38/ Danny Trayer, An Economic Analysis of Irrigation With a Limited Supply of Water in Southwest Kansas, Matters Report, Kansas State University, Manhattan, Kansas, 1967, p. 32.

a. Flood System Development

The South Dakota cost study in 1970 indicated that it cost $14,400 for developing a gated pipe flood system for 156 acres or an average of $92 per acre.39/ This paid for the well installation and $12,000 worth of land leveling. The well depth was 100 feet.

Whipps has budgeted costs in Southwest Kansas in 1970 for 160 acres, a 200-foot well and land leveling at $9,600. His total development costs for well and leveling for flood irrigation was $12,600 or $79 per acre. His well cost was spread over 160 acres or four more acres than the South Dakota study and his leveling costs were lower.40/ 41/

The irrigation demonstration farm of Clinton Holdeman in Harvey County, Kansas had a development cost for a well watering 79.9 acres of $6,901 or $75.23 per acre. The Eugene Wolf farm had a total cost of $5,825 or $97.73 per acre on 59.6 acres.42/

39/ Wallace G. Anderud, Ralph Sorenson, Sidney Block, Irrigation Costs and Returns, Extension Circular 680, Cooperative Extension Service, South Dakota State University, Brookings, South Dakota, 1970, p. 3.

40/ Loren Whipps, Economics of Irrigation, Cooperative Extension Service, Kansas State University, Manhattan, Kansas, MF-238, Sept. 1970, p. 8.

41/ Trayer in his 1960 - 1966 study of 54 wells developed in Southwest Kansas found that the wells of 800 gallons per minute and under 300 feet deep, cost $16.39 per foot of well. This included hole, casing, and gravel pack. This may guide the reader with different well depths than those cited.

42/ Harvey County Irrigation Demonstration Farms, Agriculture Engineering, Kansas State University, Manhattan, Kansas, 1969, p. 31. NOTE: These are farms that cooperate with the Agriculture Extension Engineers in keeping detailed records and following recommended cultural practices and allow the findings to be reported.

Table 16 gives a comparison of these three studies.

TABLE 16.--COMPARISON OF DEVELOPMENT COSTS FOR FLOOD IRRIGATION

Study Cited	Leveling Costs	Well Costs	Total Development	Acres In Study	Cost Per Acre
South Dakota 1970 100 foot well	$12,000	$2,400	$14,400	156	$92
Southwest Kansas 1970 200 foot well	$ 9,600	$3,000	$12,600	160	$79
Harvey County 1968 well (Holdeman)	$ 4,891	$1,200	$ 6,091	79.9	$76.23
Harvey County 1969 well (Wolf)	$ 4,548	$1,277	$ 5,825	59.6	$97.73

b. Center Pivot Sprinkler Systems Development Costs

Sprinkler irrigation has grown in popularity in recent years. It has many advantages over flood irrigation, but also some disadvantages.

The planning and design steps in sprinkler irrigation differ somewhat from flood irrigation:

1. The amount of available labor should be evaluated.
2. A smaller water supply per minute may be utilized.
3. Soil intake should be greater and root zone depth may be less than necessary for flood systems.
4. Topography may be more undulating than for flood systems.

Sprinklers are divided into (1) hand move, (2) mechanical, and (3) solid set. Hand move systems are declining in use because of the higher costs of labor. The solid set is used mainly for speciality crops with a potential for high returns per acre. They have a high initial cost of $300 to $500 per acre.

Mechanical systems are used most commonly today. They include side-roll, end-tow, carriage with trailing lines, rotating-boom, fixed lateral pipe, large volume wheel carts, and the self-propelled models.

The most popular of the above is the self-propelled type. This type may be sub-divided into straight self-propelled, circular self-propelled and moving boom with a drag line.43/ Circular or center pivot self-propelled units are being used the most in South-Central Kansas.

43/ Loc. cit., Pair, p. 5-27.

Alleged advantages of center-pivot, self-propelled units are:

1. The system will operate on grades of 5% to 7%, therefore, eliminating the need for much land leveling. The farmer, thereby, saves the cost of leveling the land and also does not decrease fertility by movement of the topsoil.

2. A self-propelled system requires very little labor to operate and maintain. A self-propelled system will probably not require more than two or three hours labor every three days, for adjustment, routine maintenance, tune-up, repairs, etc.

3. A self-propelled system saves water. A self-propelled system will operate one-fourth to one-third the amount of water required with other systems and with flood irrigation.

4. A self-propelled system will provide a better water distribution pattern than any other type of irrigation system. In addition, herbicides and insecticides may be applied through a system, in which case, a good distribution pattern becomes imperative.

5. The self-propelled system has the ability to control ground temperature. This is important on crops such as potatoes, cotton, etc., and can also be beneficial to other crops such as corn.

Offsetting these advantages are the additional expense due to the initial cost of the system and the additional power required to operate the system. Also, these systems generally have high application rates which necessitate that they be used on soils with water intake

rates high enough to absorb the water being applied.44/

The equipment costs are often higher for sprinkler irrigation than a similar size acreage of flood irrigation.

Pair presented the formula $Q = 450 \frac{AD}{FH}$ to determine the basic capacity requirements at peak use rates for sprinkler systems.

Q = sprinkler in the design area.

A = acreage in the design area.

D = gross depth of application in acre-inches per acre.

F = the number of days allowed for completion of one irrigation.

H = the number of hours the system is operated in a day.45/ The 450 is equal to one cubic foot per second or 450 gallons per minute.

This formula when used by the farmer to check his requirements can tell him and the salesman what size sprinkler unit he needs and in turn the probable initial cost.

When developing land for sprinkler irrigation the well costs could be expected to be very similar to the costs found for flood irrigation. Land leveling and shaping is usually less expensive. This is illustrated by a comparison of Table 16 with Table 17 from similar study areas where the major difference is in water application methods.

44/ H. Engle, Irrigation Development, Adjustment and Implication for Northwest Kansas, Masters Theses, Kansas State University, 1968 l. 34-35. NOTE: Mr. Don Baker, Volmont Industries, Vally, Nebraska, supplied some of the imformation in a letter of February 15, 1968.

45/ Loc. cit., Pair, p. 41.

Table 17 shows the development costs in the studies cited.

TABLE 17.--COMPARISON OF DEVELOPMENT COSTS FOR CENTER PIVOT SPRINKLER IRRIGATION

Study Cited	Land Forming	Well Costs	Total Development	Acres In Study	Cost Per Acre
South Dakota 1970 100 foot well	$500	$2,400	$2,900	138	$21.00
Southwest Kansas 1970 200 foot well	---	$3,000	$3,000	132	$22.73
Harvey County 1969 90 foot well	---	$1,536	$1,536	58.7	$26.18

2. Initial Equipment Costs

After the initial development the next step is selection of the proper equipment for the system. Equipment costs can be expressed by the formula Ec = mc + pc + ac where:

Ec = irrigation equipment costs.

mc = motor or power costs (includes motor base and fuel supply.

pc = pump costs.

ac = pipe for distribution.

The annual recovery cost (ec) formula can be expressed as:

$$ec = \frac{mc}{y} + \frac{pc}{y} + \frac{ac}{y} - S$$

y = expected life of each piece of new equipment.

s = salvage value if any.46/

Ec may be lowered by purchasing used equipment or by leasing equipment, but in such cases ec may not be changed a great deal due to a shorter expected life span of the equipment or the annual lease payment.47/

46/ Ibid., p. 36.

47/ Some farmers with low capital supplies may be tempted to short cut the development fixed costs by beginning with a well, undersize pump, used automotive engine, open ditches, and land planing or any one or more of these techniques. Their desire, of course, is to lower capital needs and to get on with the job of watering. This may be done in some cases at the expense of less than optimum yields, added operating costs, and extra labor.

a. Flood Irrigation Equipment

Pump selection depends a great deal upon the depth to water, head and capacity of the well. Many of the older wells in South-Central Kansas have less expensive centrifugal pumps. Most of the new wells and those serving sprinkler systems are using multi-stage turbine pumps.

Natural gas, butane, or gasoline engines for normal service cost about $20-$25 per rated horsepower. An engine for a 1,000 gallon per minute well with a 40-foot lift running at normal efficiency costs $600-$700. The formula to use for calculating this price is:

$$\text{required horsepower of engine unit} = \frac{\text{gallons per minute X lift}}{1700} \text{ or } \frac{1{,}000 \text{ gpm X } 40'}{1700} =$$

23.5 HP.48/

This is multiplied times cost per rated horsepower, $20-$25 in this case. The expected price should be between $470 to $587.

Power supply sources used in the study area include LP gas, natural gas, and electric powered motors. Motors differ a great deal in price depending upon horsepower and revolutions per minute. Industrial motors with lower r.p.m.'s are the more expensive initially, but may be cheaper annually since they have a longer life expectancy with less maintenance costs.

Electric drive turbines cost $1,200-$1,300 with direct drive motors. The electric motor size formula is calculated by: required

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48/ Personal interview with Federal Land Bank Appraisal Engineer, Wichita, Kansas, December 1970.

horsepower of electric motor = $\frac{\text{gallons per -minute X lift in feet}}{2600}$.

From this the correct motor size can be purchased. Three phase electric current is the cheapest if available or a conversion box can be installed. For a 1,000 gallon per minute well with a 40-foot lift the electric motor should be 15.4 HP. This size motor is quoted at about $700-$800 installed. Electric motors are more efficient in their power output, so they may be smaller than fuel engines doing the same job.

Trayer's study in 1960-66 found that power units cost $1,200 each when lifting 150 feet or less and 1,600 gallon per minute or less.49/ Turbine pumps for the same size well cost $1,875 on the average.

Eight or ten inch gated aluminum pipe is needed for a 1,000 gallon per minute well to avoid extra head loss. It will cost $1.40 to $1.70 per foot at 1971 prices.

Underground concrete pipe varied from $1.45 to $2.95 per foot installed depending upon size and manufacturer. Twelve inch pipe would carry 900 to 1800 gallons per minute and cost $1.65 to $2.15. Plastic 12 inch pipe costs about $1.75 per foot installed and is being used more than concrete in many areas. Total costs for underground pipe vary depending upon well location and field size, also.

In the South Dakota study the total equipment costs including four sets of distribution pipe was $12,700 or $81.41 per acre watered.

The Southwest Kansas study cited earlier used only one set of distribution pipe, but a larger pump and motor. Their equipment costs

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49/ Loc. cit., Trayer, p. 37 table 4 and 5.

totaled $8,846 or $55.29 per acre.

A re-use pit, pump and pipe costing $2,360 was used on the Holdeman farm in Harvey County. With this additional piece of equipment that was not used on the previous two examples, the total equipment costs was $8,727 or $109.22 per acre. This example had a shallower well than the other two studies, which required less expensive pumping and power equipment. The cost per acre ($109.22) was higher due to the smaller acreage in the unit. It was equipped to handle at least 80 acres more with little additional outlay of money for equipment. The Wolf farm had a total equipment cost of $4,284 or $71.87 average cost per acre.

b. Center Pivot Sprinkler Irrigation Equipment

Comparative studies of sprinkler and flood irrigation point out a significant difference in equipment needs and, in turn, initial costs. The pumping needs are not too different for the same pumping lift and capacity. The power needed for sprinklers is usually a good deal greater than flood due to the extra head, friction losses, and pressures needed.50/ The surface pipe is of different design and usually much more expensive per foot for sprinklers. In South-Central Kansas the center-pivot, self-propelled sprinkler is used most commonly. They are more expensive per foot of surface pipe than the gated pipe used in the flood irrigation examples.

The South Dakota study indicated a total cost of $25,000 or $181.15 per acre for center-pivot sprinkler equipment. This compared with $24,660 for equipment or $186.81 per acre for the Southwest Kansas study.

The equipment cost for the Clinton Holdeman demonstration farm was $11,585 or $197.35 per acre. A word of caution should be given to the reader who might consider developing less than a so-called 'quarter section circle' and use this cost as a guide. This farm was using a 'full quarter section circle' system, but allocated the equipment costs on only a one-half basis on the demonstration. The system was also

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50/ HEAD - is a term that describes in feet the difference in elevation between the static water level and the discharge point of the water. More head is required for sprinklers since the water is forced higher at greater pressure than in the case of flood irrigation.

used on an adjoining farm not included in the demonstration. A similar system developed for only a 58.7 acre field would be expected to have equipment costs on both a per acre basis and total basis of more than was shown here. This is due to the fixed per unit costs for such items as motor, pump, gearhead, fuel supply and sprinkler pivot point, no matter how many acres they serve.

Table 18 gives a breakdown of the various equipment costs for the cited studies.

3. Total Investment Costs

a. Flood System

The South Dakota cost study in 1970 found that it cost $27,100 for developing and equipping a gated pipe flood system for 156 acres or an average investment of $173.71 per acre. Of this cost $12,000 was land leveling cost, some of which might be charged to permanent improvement. The well depth in this study was 100 feet. The annual investment recovery cost was $1626 or $10.42 per acre when the land leveling and well cost is recovered over 25 years.

Whipps has budgeted costs for Southwest Kansas for 160 acre, 1,000 gallon per minute wells of 100 feet lift and 200 feet depth to have fixed investment of $21,446 or $134 per acre. He has shown that the annual recovery of investment costs would be $821 per 160 acres or an annual recovery of investment cost per acre of $5.13. This included the assumption that the original fixed cost of $9,600 for land forming would be recovered in 25 years.

The total fixed investment for the flood irrigation system on the Clinton Holdeman farm for 79.9 acres and a shallow well was $12,458 or $155.91 per acre. The annual investment recovery cost is $1028 or $12.87 per acre.

The total fixed investment for the Eugene Wolf farm was $10,109 or $126.52 per acre. The annual investment recovery cost is $639 when the land leveling cost is recovered over a 25 year period. The annual investment recovery cost is $10.72 per acre.

TABLE 18.--COMPARISON OF INITIAL EQUIPMENT COSTS

FOR FLOOD AND SPRINKLER IRRIGATION

Study Cited	South Dakota		Southwest Kansas		Clinton Holdeman Farm		Eugene Wolf Farm
Type System	Flood	Sprinkler	Flood	Sprinkler	Flood	Sprinkler[b]	Flood
Power	$3,500	$ 6,200	$1,200	$ 3,000	$ 866	$ 1,544	$2,435
Pump & Gearhead			$3,310	$ 3,760	$1,443	$ 1,547	
Fuel Supply	---	---	$ 300	$ 400	$ 90	$ 135	---
Surface Distribution System	$9,200	$18,800	$4,036	$17,500	$3,969	$ 8,360	$1,848
Re-use Pit, Pump and Pipe	---	---	---	---	$2,360	---	---
Total Equipment Cost	$12,700	$25,000	$8,846	$24,660	$8,727[a] ($6,367)[a]	$11,585	$4,284
Acres	156	138	160	132	79.9	58.7	59.6
Cost Per Acre	$ 81.41	$181.15	$55.29	$186.81	$109.22 ($ 79.68)[a]	$197.35	$71.87

[a]Re-use Pit, Pipe and Pump excluded.

[b]Only one-half of the total equipment costs were allocated to this study on this demonstration farm.

b. Center-Pivot Sprinkler System

Total fixed investment for a 138-acre, center-pivot sprinkler system in 1970 in South Dakota was $27,900 or $202.15 per acre. The annual recovery cost was $1,904 or $13.80 per acre.

The Southwest Kansas study indicated total investment of $27,660 for center-pivot sprinklers or $209.53 per acre irrigated. There was an average annual recovery of investment cost of $1,303 per quarter section. This fixed annual recovery cost per acre irrigated in Whipps' budget study was $9.87 vs $5.13 for flood irrigation under similar conditions.51/ Higher investment costs for sprinkler irrigation tend to be offset by lower operating costs, especially on sandy soil.52/

The Harvey County demonstration farm had total investment costs of $13,122 or $223.54 per acre for the 58.7 acre system. Annual fixed recovery of investment costs are $761 or $12.87 per acre. This includes the well, power unit, pump, and sprinkler.

Keeping in mind differences in type of equipment used, differences in size of equipment and differences in acreage irrigated, the studies cited here can be considered as illustrative of costs of irrigation development in South-Central Kansas.

4. Total Fixed Costs

Up to this point investment costs and in turn annual recovery

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51/ Loc. cit., Whipps, p. 8.

52/ George Chandler, "Wake Up Bankers", Irrigation Age, Vol. 5, No. 5, 164 Wall Street, Dallas, Texas 75215, December 1970, p. 105.

of those investment costs have been discussed. Annual recovery of the original investment or depreciation is one of the important fixed costs to consider in irrigation, but not the only one. Other fixed costs are interest on the invested dollars, taxes, insurance, and repairs.

a. Flood Total Fixed Costs

The average annual total fixed costs for the South Dakota study was $3,731 or $23.92 per acre. The land leveling and well was amortized over 25 years, nothing was considered for repairs, and the interest on the investment was eight percent.

Whipps budget study found that average annual total fixed costs were $2,048 or $12.80 per acre. The land leveling was amortized over 25 years, six percent return on investment and no insurance cost was included. When eight percent return on the investment is used the average annual fixed costs went up to $13.94 per acre.

The total average annual fixed costs for the flood irrigation system on the Clinton Holdeman farm was $2269 or $28.39 per acre. Interest on investment was figured at eight percent, the land leveling was amortized over 25 years, and no cost for insurance was considered.

The total average annual fixed costs for the Eugene Wolf farm was $1335 or $22.40 per acre. This study included eight percent return on the investment, 25 years amortized on the land leveling and no cost for insurance was included.

b. Sprinkler Total Fixed Costs

The average annual total fixed costs for the South Dakota study was $3,740 or $27.10 per acre. Land leveling and well amortized for

25 years, nothing was charged for repairs, and the interest on investment was eight percent.

The Southwest Kansas study by Whipps showed that the average annual fixed costs were $2,954 or $22.38 per acre. There was no land leveling or insurance charged on this budget. Interest on the investment was figured at six percent. When eight percent return to investment was charged the average annual fixed cost went to $23.80 per acre.

The Holdeman farm in Harvey county had average total fixed costs of $2,400 or $40.88 per acre. The interest on investment was eight percent. No cost for insurance was available on this operation. Table 19 compares reported total average annual fixed costs for flood and sprinkler irrigation.

5. Operating Costs For Irrigation Application

Operating costs for water application are expenses incurred only when an installed irrigation system is being used. Operating costs for water application are also referred to as variable costs. Variable costs for irrigation consist of many factors and are dependent upon many variables. Varying water requirements under different irrigation conditions is a major reason for variation in operating costs per acre. Variable costs for irrigation application can be compared when acre inches per acre are known and divided into the total variable application costs to find a commonly used cost per acre inch pumped. Variable cost of application per acre irrigated is also another common comparative factor that will be used in this paper.

TABLE 19.--COMPARISON TOTAL ANNUAL FIXED COSTS

FOR FLOOD AND SPRINKLER IRRIGATION

Study Site	South Dakota		Southwest Kansas		Clinton Holdeman Farm		Eugene Wolf Farm
Type System	Flood	Sprinkler	Flood	Sprinkler	Flood	Sprinkler	Flood
Depreciation (Includes Land Leveling & Well on 25 year amortization)	$1626	$1905	$ 821	$1303	$1029	$ 761	$ 640
Taxes	$ 340	$ 400	$ 238	$ 247	$ 149	$ 196	$ 83
Interest on Investment	(8%) $1655	(8%) $1135	(6%) $ 733	(6%) $ 753	(8%) $ 794	(8%) $1049	(8%) $445
Insurance	$ 110	$ 300	---[a]	---[a]	---[a]	---[a]	---[a]
Repairs	---[a]	---[a]	$ 256	$ 651	$ 297	$ 394	$ 167
Total	$3731	$3740	$2048	$2954	$2269	$2400	$1335
Acres	156	138	160	132	79.9	58.7	59.6
Cost Per Acre	$23.92	$27.10	$12.80[b] ($13.94)	$22.38[b] ($23.80)	$28.39	$40.88	$22.40

[a]The annual fixed costs were not available from these studies.

[b]Where 8% return on investment was substituted for the quoted 6% the annual fixed cost per acre would be $13.94 for flood and $23.80 for sprinkler irrigation.

The variable cost of application formula is:

$$Oc = fc + rc + lc + at + d$$

Oc = operating costs

fc = fuel and oil cost

rc = repair costs

lc = extra labor cost

d = depreciation due to hours of use (usually considered in repairs).53/

Not all studies of variable costs of irrigation application include all of these factors in their total of variable costs. For this paper all examples cited will include these factors as variable application costs unless mention is made of any change.

Swanson observed:

> "The water requirements of grain sorghum is not a fixed value. In hot years transpiration by the plant is higher than in cool, relatively humid seasons. Low relative humidities, high temperatures, and wind movement also increase evaporation from the soil surface, adding further to the consumptive use. Restricted soil moisture reduces transpiration. Frequent irrigation increases evaporation. Unavoidable run off of rainfall and irrigation water or losses by deep percolation increases the water required."54/

In their work at Garden City from 1954 to 1959, Musick and Grimes found that grain sorghum uses 22 to 24 inches of water during the

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53/ Loc. cit., Trayer, p. 38 and Sohrohi, p. 76.

54/ Norris P. Swanson and E. L. Thaxton, Requirements for Grain Sorghum Production in the High Plains, Texas Agriculture Experiment Station, Bulletin 846, 1957, p. 2.

growing season.55/

Otto stated in the sprinkler irrigation study in South-Central Kansas in 1954, that 16.4 inches per acre of water was added to normal rainfall to alfalfa. Wheat had 4.7 inches per acre, grain sorghum 8.7 inches per acre, forage sorghum 8.3 inches per acre, and pasture grasses 11.5 inches per acre in the same study.56/ It should be noted that this study was of hand-move sprinklers where an average of 498 gallons per minute of the 1,062 gallons per minute well capacity was being pumped. The combination of low capacity units and extra hard labor to move the system might have discouraged optimum use of water.

Returns of Farm Management Association members in South-Central Kansas show an average of 21.9 inches of water pumped per acre in 1968 and 14.66 inches in 1969. The range for 1968 was from 8 inches per acre to 43 inches per acre. For 1969, the range was 4 to 24 acre inches.57/ The different management levels, application efficiencies,

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55/ Jack Musick and Donald W. Grimes, Water Management and Consumptive Use by Irrigated Grain Sorghum in Western Kansas, Kansas Agriculture Experiment Station, Manhattan, Kansas, Bulletin 113, February 1961, p. 6.

56/ Merton L. Otto and Wilfred Pine, Sprinkler Irrigation Costs and Returns South-Central Kansas, Agricultural Experiment Station, Kansas State College, Manhattan, Kansas, Bulletin 381, 1956, p. 3.

57/ Data obtained on selected farms from Kansas Water Resources Board records in Topeka, Kansas. The farmer supplies hours pumped and acres watered. The Water Resources Board test and wells periodically. A formula to determine the acre inches per acre was used. It is: $\frac{HP \times GPM}{452 \times Au} = Aipa$ Hp = hours pumped, GPM = gallons per minute, Au = acre watered, Aipa = acre inches per acre.

types of crop grown and the natural rainfall affected the amount pumped.

The rainfall over the area was much more plentiful in 1969 than 1968. This coupled with more carry-over of soil moisture from the previous year, affected the average between the two years probably the most.

Trayer found in his 1966 study of 155 units, that annual repair costs per power unit averaged $267.91.58/ These costs were for deeper wells and generally larger capacity power units than used in South-Central Kansas. Pump and well repairs for 95 units in Trayer's study averaged $186.57 each. Total repairs for the power unit, well and pumps averaged $454.48 or 21.38¢ per hour of pumping. All of these units were for flood irrigation systems.

A total of 2.143 hours of labor per day per well was used to pump and distribute water in the South Dakota study cited earlier.59/ Labor for gated pipe in the South Dakota study showed a need for 4.9 hours per acre per crop year for corn grain, 6.25 hours for silage corn, 6.17 hours for alfalfa, and 3.25 hours for small grains.

Fuel costs are outlined by Whipps. These are shown in table 20.60/ In South-Central Kansas the 100 foot of head would be very sufficient for flood irrigation.

Depreciation for obsolesence is not a variable cost, but is usually considered a fixed cost. However, depreciation for wear and

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58/ Loc. cit., Trayer, p. 41.

59/ Loc. cit., Aanderud, p. 48.

60/ Loc. cit., Whipps, p. 6.

tear associated with use is usually considered a variable cost factor.

TABLE 20.--CALCULATED FUEL COST FOR IRRIGATION[a]

Per Acre-foot Of Water At Various Head Values

Fuel	(Head Values) 100	200	300	400
LP Gas Cost/Gal.				
9¢	$1.80	$3.60	$5.40	$7.20
10¢	2.06	4.12	6.18	8.24
11¢	2.27	4.54	6.81	9.08
Diesel Cost/Gal.				
13¢	1.76	3.52	5.28	7.04
14¢	1.89	3.78	5.67	7.56
15¢	2.03	4.06	6.09	8.12
Gasoline Cost/Gal.				
16¢	2.60	5.20	7.80	10.40
17¢	2.75	5.50	8.25	11.00
18¢	2.90	5.80	8.70	11.60
Natural Gas Cost/1,000 ft.^{3}				
25¢	.56	1.12	1.68	2.24
35¢	.80	1.60	2.40	3.20
45¢	1.02	2.04	3.06	4.08
Electricity Cost/KW				
1.5¢	2.27	4.54	6.81	9.08
2.0¢	3.02	6.04	9.06	12.08
2.5¢	3.78	7.56	11.34	15.12

[a]Loren Whipps, Economics of Irrigation, Kansas State University, MF-238.

6. Additional Field Costs Associated With Irrigation

Additional costs over dryland for tillage in South-Central Kansas is generally limited to a furrowing operation for flood and sprinkler irrigation both at a cost of $ .75 to $1.00 per acre. Additional harvesting costs over dryland for irrigation would be expected to be in linear relationship to the additional bushels harvested, if custom harvested. It is common to charge for additional bushels over a base amount that would be less than the amount normally expected under irrigated conditions.

Many studies show total variable costs to include tillage, fertilizer, chemicals, application of water and harvesting costs for the crop. Several examples expressed this way are used in this paper.

a. Total Variable Costs Associated With Flood Irrigation

A Nebraska study of irrigated corn using records from 14 producers, showed a range of total variable costs from $29.89 to $68.42 per acre and averaged $45.73 in 1969. The acre inches of water used was not available.61/

Budgeted total variable costs by Peters and Howell for the Oklahoma Panhandle for variable costs including tillage, indicate the following: wheat -- $26.07, alfalfa -- $107.22, grain sorghum -- $49.03, corn for grain -- $79.19 and corn silage -- $51.64.62/ No labor cost

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61/ Jim Greer, "Costs and Returns of Irrigated Corn Production in Adams County, Nebraska, 1969", Cornhusker Economics, Cooperative Extension Service, Nebraska University, Lincoln, Nebraska, December 17, 1969, p. 1.

62/ Larry R. Peters and Jim V. Howell, unpublished budget for Oklahoma Irrigation Costs and Returns 1970, Texas County Extension Service, Guyman, Oklahoma, 1970.

was included in their budgets.

A budget approach was used by Whipps in comparing total variable costs including tillage between corn for grain and grain sorghum. The variable costs totaled $60.00 per acre for corn for grain and $56.00 per acre for grain sorghum. Labor was paid in these budget figures.63/

South Dakota's study of corn total variable production costs of $55.70 per acre. The main difference being in $3.05 more per acre for field operations associated with harvesting and $4.50 more per acre for extra fertilizer. These figures did not include labor, but it did include tillage costs.64/

In 1969, the Clinton Holdeman farm had total variable costs for the flood irrigation system averaging $47.25 per acre for corn grain.65/

The Eugene Wolf farm had total variable costs of $49.65 per acre. Tillage costs did not consider repairs, but only fuel and oil at the standard rate of 60¢ per tractor hour. Actual custom harvesting costs were used on the Holdeman farm, but fuel and oil only were considered on the Wolf farm. Allowances should be made for these costs by an irrigation developer.

Table 21 compares the studies and the various operating costs

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63/ Loc. cit., Whipps, p. 1-11.

64/ Loc. cit., Aanderud, p. 8, table 6.

65/ Loc. cit., Demonstration Farm, p. 17-19.

considered in these studies for corn. Table 22 presents similar information for grain sorghum.

b. Total Variable Costs Associated With Center-Pivot Sprinkler Systems

Some variable costs of irrigation are higher for sprinkler irrigation than for flood irrigation. Higher costs result from extra fuel needs for extra head demands and repairs on the mechanical equipment. However, increases may be at least partially off-set by savings in variable labor requirements for the center-pivot sprinklers over the gated pipe flood method.

South Dakota researchers calculated the field operation and water application labor requirements for center-pivot sprinklers over gated pipe. For silage corn it was 4.75 hours per acre for a savings of 1.5 hours over flood systems. Alfalfa was 4.85 hours vs. 6.7 hours and small grains was 2.15 hours per acre vs. 3.25 hours per acre for flood irrigation.66/

On the Clinton Holdeman demonstration farm, the labor averaged 4.01 hours per acre for flood irrigation and 2.28 hours per acre for center-pivot sprinkler systems. This seems to indicate that it takes 1.7 hours per acre less to farm and operate a circle system than a flood system.

Total variable costs were available on a fairly comparable basis for three studies. They are reviewed in table 23. The Southwestern Kansas circle system study was adjusted by the author to allow for one-third less labor cost than on a similar flood system so that it could be compared. It still has labor costs for tillage, harvesting,

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66/ Loc. cit., Aanderud, p. 4.

and water distribution which are not included in the South Dakota or Harvey County examples.

TABLE 21.--COMPARISON OF VARIABLE COST PER ACRE

FOR FLOOD IRRIGATION OF CORN GRAIN

Study Cited	Oklahoma	South Dakota	Southwest Kansas	Harvey County Av. (Holdeman)	Harvey County Av. (Wolf)
COSTS					
Seed	$ 6.00	$ 5.50	$ 3.00	$ 5.99	$ 6.20
Fertilizer	14.95	16.50	18.00	18.97	29.69
Herbicide	4.50	5.00	6.00	4.68	2.18
Insecticide	3.50		3.00	2.49	3.18
Crop Insurance	8.80	4.50	----	----	----
Tillage Costs	4.57	7.35	4.50	1.12 (Fuel Only)	1.76 (Fuel Only)
Harvesting and Handling	26.00		12.50	12.40	.67
Interest On Capital	1.22	2.65	----	----	----
Watering	9.65[c]	5.00	13.00[c]	1.59[b] (Fuel, Oil & Misc.)	5.97[b] (Fuel, Oil & Misc. only For 2 Motors)

Total Variable	79.19	46.70	60.00[a]	47.26[a] (40.05 with no labor)	49.65[a] (42.31 with no labor)
Acre Inches Water Applied	24"	----	18"	20"	20.45"
Application Cost Per Acre Inch	.40	----	.72	.08	.29
Estimated Labor Per Acre	5.73hr	4.90hr	----	4.01hr	4.19hr

[a]A payment for all labor is included.

[b]Repairs should be added to make comparable with other studies.

[c]Deeper wells that required larger units that were more expensive to operate than other studies.

TABLE 22.--COMPARISON OF VARIABLE COSTS PER ACRE FOR FLOOD IRRIGATION, OF GRAIN SORGHUM, OKLAHOMA AND SOUTHWEST KANSAS STUDIES[b]

	Oklahoma	Southwest Kansas
COSTS		
Seed	$ 2.20	$ 1.50
Fertilizer	8.13	15.00
Herbicide	4.50	5.50
Insecticide	2.00	----
Crop Insurance	4.80	----
Tillage Costs	4.57	12.00
Harvesting and Handling	12.40	12.00
Interest *On Capital*	.78	----
Irrigation Application	9.65	10.00
Total Variable	49.03	56.00[a]
Acre Inches Water Applied	24"	----
Application Cost Per Acre Inch	.40	----
Estimated Labor Per Acre	5.73 hrs.	----

[a]*A payment for labor is included.*

[b]Peters and Howell, unpublished budgets for Oklahoma Irrigation Costs and Returns 1970, Texas County Extension Service, Guyman, Oklahoma, and Whipps, Economics of Irrigation, Kansas State University, MF-238.

TABLE 23.--COMPARISON OF VARIABLE COST PER ACRE

FOR CENTER-PIVOT IRRIGATION SYSTEMS ON CORN FOR GRAIN

	Clinton Holdeman, Harvey County, Ks.	South Dakota	Southwest Kansas
COSTS			
Seed	$ 7.51	$ 5.00	$ 3.00
Fertilizer	22.28	16.50	18.00
Herbicide	4.97	5.00	6.00
Insecticide	2.40		3.00
Crop Insurance	----	4.50	----
Tillage Costs	.78 (Fuel Only)	7.50	4.50
Harvesting and Handling	12.41		12.50
Interest On Capital	----	3.25	----
Irrigation Application	1.86 (Fuel & Oil Only)	16.00	25.00[b] (20.00 No Labor)
Total Variable	52.21[b] (48.22 with no labor)	57.30	72.00[a&b] (With estimated labor adjustment out = $67.00)
Acre Inches Water Applied	13.97"	----	18"
Application Cost Per Acre Inch	$ .13		$ 1.11
Estimated Labor per Acre	2.28 hrs.	3.35 hrs.	----

[a]These figures were the authors calculations based on Whipps' data. They include additional costs for repairs and fuel as determined by Whipps on page 8 of Economics of Irrigation, but no labor adjustment.

[b]A payment for labor is included.

C. COST AND RETURNS RELATIONSHIPS OF IRRIGATION

1. Expected Yields Under Irrigation Compared With Dryland Farming

In a study at the Garden City Experiment Station from 1958-1965, the average yield for irrigated grain sorghum with application of 150 pounds of nitrogen per acre per year was 125 bushels per acre. A study by Musick and Grimes67/ at Garden City, again under experiment station conditions, from 1954-59 revealed that the average yield for dryland fallow grain sorghum was 31.8 while full irrigation of 5 waterings averaged 116.3. Four waterings produced an average of 112.4 bushels per acre.

Grimes, Herron, and Musick found in 1954-59 at Garden City that wheat which was watered at pre-plant and boot stages averaged 48.6 bushels vs 21 bushels on dryland. They also determined it needed about 24 inches of moisture for optimum development.68/ Experiment Station data from Garden City for 1969 and 1970, showed yields and ranges for irrigated crops as indicated in table 24.69/

Another check of what possible irrigation yields might be expected is the high yield demonstration clubs that several Southwestern Kansas county extension councils and chambers of commerce jointly sponsor each year. These are usually the top yields in the

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67/ Loc. cit., Musick and Grimes, p. 8.

68/ Donald Grimes, George Herron, and Jack Musick, Irrigation and Fertilization Winter Wheat in Southwestern Kansas, Garden City Exp. Station, Kansas State University Experiment Station, Manhattan, Kansas, Bulletin 442, February 1962.

69/ 1970 Annual Experiment Station Reports, Kansas State University, Manhattan, Kansas, Bulletin 534 and Report of Progress 164 and 159, 1970.

TABLE 24.--IRRIGATED YIELDS AT GARDEN CITY EXPERIMENT STATION[a]

Crop	Low	High	Average
Forage Sorghum	15.7 Tons/Acre	29.8 Tons/Acre	28.1 Tons/Acre
Wheat (1970)	52.0 Bushels/Acre	80.0 Bushels/Acre	67.0 Bushels/Acre
(5 yr. Average of 6 varieties)	54.0	60.0	57.0
Corn Grain 1969	103.0	210.0	150.0
Grain Sorghum 1969	103.0	152.0	131.0
(4 yr. average 11 entries)	119.0	137.0	127.0

[a]1970 Annual Experiment Station Reports, B. 534, 531 & R. of P. 164 & 169.

county. Grant, Stevens, Finney, Stanton and Morton counties have sponsored these demonstrations for several years. The[70] average production for the past few years is summarized in table 25 for four of five counties.

Very little study has been made of these data in marginal analysis frame. The author attempted to obtain cost data on farms entered in the contest in Stevens County in 1966. The data was rather incomplete, but indications were that the top three to five producers were applying extra heavy amounts of fertilizer per acre which suggested marginal costs that exceeded marginal returns. However, these contests are proving valuable as demonstrations or production possibilities under irrigation. They allow a free exchange of cultural practices that are being used in the counties by the better farmers when economically suitable.

Experiment station data for the St. John Station in Stafford County is probably more representative of yields that can be obtained in the eleven-county study area, at least on sand soils under irrigation. Stafford County data is shown in table 26.

70/ Annual Summaries for the counties were furnished by County Agriculture Agents, Marshall Walker, Al Madis, R. D. Ford, Herbert Williams and James Carson.

TABLE 25.--SELECTED DATA FROM HIGH YIELD CLUBS IN SOUTHWEST KANSAS ON IRRIGATED CROPS

Crop	Number Of Farms	Average Acres Per Farm	3 Year Average Yield Per Acre	Top Yield	No. Over 100 Bushels of Grain
Corn Grain	86	69.6	149 Bu.	201.1	65
Grain Sorghum	188	38.52	126 Bu.	160.5	155
Silage	4	61.0	22 Bu.	24.9	---

TABLE 26.--IRRIGATION YIELDS AT ST. JOHN EXPERIMENT FIELD 1969-1970[a]

Crop	Low	High	Average
Grain Sorghum 1969	70 Bushels/Acre	113 Bushels/Acre	102.2 Bu./Acre
Grain Sorghum 1970	72	104	86.9
(3 yr. Average 10 Hybrids)	93	104	99
Corn 1969	76	146	114
Corn 1970	104	162	137
Corn Silage 1970			20 Tons
Soybeans 1970		(Early Maturing)	49 Bu./Acre

[a]1970 Data and Related Information, Sandyland Experiment Field, Kansas State University Experiment Station, Manhattan, Kansas, Tables

To compare dryland results we can look at the Stafford County Station data again for the same years as shown on table 26. The 1970 grain sorghum dryland average was 42 bushels per acre. The range was 40 to 46 bushels per acre. In the very wet year of 1969 the average was 94 with a range of 72 to 108 bushels per acre. Irrigated production out yielded the dryland average by only eight bushels per acre in 1969, which could not be expected to reflect a return over added variable costs for irrigation.

The three year average for five hybrids tested every year, including the excellent 1969 crop year, was 68.66 bushels per acre vs. the irrigated yield of 99 bushels per acre. A more typical rainfall year for the area, (1970) showed a difference of 45 bushels per acre or more than enough to cover extra variable costs expected for irrigation and usually more than enough to cover extra total costs.

Dryland wheat has averaged 36 bushels per acre over 3 years for 11 varieties. There has been no study of irrigated wheat yields at the Stafford County station.

Corn yields on the Mitchell County Irrigation Demonstration Farm in 1967 varied from 50 to 115 bushels per acre. The low yield was attributed to recent leveling and poor stands due to a wet planting period. The farm averaged 88 bushels per acre. The yields varied from 61 to 105 bushels per acre in 1966. The average for this farm in 1966 was 90.5 bushels per acre.71/

71/ Annual Report Almena Irrigation District, Cooperative Extension Engineering Kansas State University, Manhattan, Kansas, 1967 and 1966.

The work that was done in 1954 with hand move sprinkler systems in South-Central Kansas indicated the yield relationship between dryland and irrigated crops as shown in table 27.

TABLE 27.--A COMPARISON OF DRYLAND YIELDS WITH HAND-MOVE SPRINKLER SYSTEMS IN SOUTH-CENTRAL KANSAS, 1954[a]

Crop	Av. Dryland Yields	Av. Irrigated Yields
Alfalfa	1.6 Ton	4.0 Ton
Forage Sorghum	*2.5 Ton*	12.0 Ton
Grain Sorghum	13 Bushel	35 Bushel
Wheat	21 Bushel	32 Bushel

[a]Otto and Pine, op. cit., p. 17.

Better varieties have been developed, more fertilizer is being used, and more intensive irrigation has raised the yields in more recent years. At the same time some of the same technical changes have improved dryland yields, so the relationships may not vary too much from today's expected difference.

2. Returns Studies

Peters and Howell in the Oklahoma Panhandle have farmer irrigation record data showing average wheat yields of 40 bushels per acre, alfalfa seven tons per acre, grain sorghum 121 bushels per acre, corn 130 bushels

per acre and corn silage 20 ton per acre.72/ Budget data showed gross returns of $102.30 per acre for 110-bushels grain sorghum, $130 per acre for 130-bushels corn, $110 per acre for 20-ton corn silage, and $185.78 per acre for seven-ton alfalfa.

Whipps on his grain sorghum vs. corn comparative cost study used grain sorghum at 120 bushels per acre and corn at 140 bushels with a 10 percent risk factor to be subtracted from the yields. With grain sorghum at 90¢ per bushel and corn at $1.00 per bushel, expected gross returns were $97 and $126 per acre.

In a 1969 study of 14 corn producers in Adams County, Nebraska, the irrigated yields varied from 122 bushels to 184 bushels and averaged 149 bushels per acre. Total operating costs varied among producers for $29.89 to $68.42 and averaged $45.73 per acre. The fixed costs varied from $11.50 to $31.77 and averaged $24.22 per acre. Their return to labor, management and land averaged $71.80 per acre when corn was sold for $1.00 per bushel.73/

In the South Dakota study referred to earlier, the expected yield for irrigated corn silage was 20 ton per acre with a price of $7.00 per ton.74/ A similar study for grain corn producing 110 bushels per acre and selling for $1.05 per bushel gave a gross of $115.50.

The flood irrigation demonstration farm of Eugene Wolf in Harvey County in 1969, had an average yield for corn of 136.26 bushels per

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72/ Loc. cit., Peters and Howell.

73/ Loc. cit., Greer, p. 2.

74/ Loc. cit., Aanderud, p. 7.

acre. The gross was $169.61. Yields varied on the three fields from 139.7 bushels to 158.7 bushels per acre.75/

The high yield plus the relative low variable costs allowed the Wolf farm a very high $97.56 return to land, labor, risk and management. Repairs for tillage, harvesting, trucking and handling were not charged against this farm as they were in all the other examples. Even if this were assumed to be as high as the Oklahoma study which would add $18.14, the remaining return to labor, land, risk and management is $79.42. This is $32.95 per acre over the Holdeman farm. This is a good example of what extra yield due to different management, weather, or many other factors can do for profits.

On the Clinton Holdeman farm the center-pivot sprinkler system produced 112.18 bushels of corn per acre at a value of $1.09 per bushel or a gross of $122.27 per acre. The flood irrigation on the same farm yielded 112.04 bushels per acre, but varied from 102.9 bushels per acre to 120.9 bushels per acre on the three different fields. It grossed $122.12 per acre or almost the same as the sprinkler irrigated land.

It would have been highly desirable if dryland yield checks for each of the study sites would have been available to compare the expected irrigation yields above dryland yields. These data were not available so it must be left up to the reader to analyze the profitability of irrigation in these studies compared to the area yield data included where possible in this paper.

75/ Loc. cit., Harvey County Irrigation Demonstration, p. 19-21.

One year and one farm results give an indication of possible returns, but should be interperted with caution because of the limited experience. These returns are summarized with the totals from earlier reporting of costs on table 28 for the studies cited.

Annual development cost recovery for well and leveling is figured on a straight line, 25 year basis on all examples.

Table 28 gathers all the previously cited studies of costs and returns on a per acre basis. Table 29 reports costs and returns per acre inch of irrigation water applied.

TABLE 28.--SUMMARY OF SELECTED STUDIES OF AVERAGE ANNUAL COSTS AND RETURNS PER ACRE ON CORN FOR GRAIN ON IRRIGATED LAND

Study Cited	South Dakota		Southwest Kansas		Clinton Holdeman Farm		Eugene Wolf	Oklahoma
Type System	Flood	Sprinkler	Flood	Sprinkler	Flood	Sprinkler	Flood	Flood
Fixed Costs								
Annual Dev. Cost Recovery	$ 3.69	$ .84	$ 3.15	$ .91	$ 3.45	$ 1.05	$ 3.90	(No Break Down)
Annual Equipment Cost Recovery	6.73	12.96	1.98	8.96	9.42	11.92	6.82	
Other Fixed Costs	13.50	13.30	8.81	12.51	15.52	27.91	11.68	
Total Fixed Costs	23.92	27.10	13.94	22.38	28.39	40.88	22.40	16.85
Water Application Variable Costs	5.00	16.00	13.00	20.00	1.59	1.86	5.97	9.65
Total Water Application Costs	28.92	43.10	26.94	42.38	29.98	42.74	28.37	26.50

TABLE .--CONT.

Other Variable Costs	41.70	41.30	47.00	46.00	45.67	50.35	43.68	69.54
Total Costs	70.62	84.40	73.94	88.38	75.65	93.09	72.05	96.04
Gross Return	115.50	115.50	126.00	126.00	122.12	122.27	169.61	130.00
Remainder[a]	44.88	31.10	52.06	37.62	46.47	29.18	97.56	33.96

[a]Remainder is for management, risk, labor, and land.

TABLE 29.--SUMMARY OF SELECTED STUDIES ON
AVERAGE ANNUAL COSTS AND RETURNS
PER ACRE INCH WATER APPLIED ON CORN FOR GRAIN ON IRRIGATED LAND

Study Cited	South Dakota		Southwest Kansas		Clinton Holdeman Farm		Eugene Wolf	Oklahoma
Type System	Flood	Sprinkler	Flood	Sprinkler	Flood	Sprinkler	Flood	Flood
Acre Inches Used	-----	-----	18"	18"	20"	13.97"	20.45"	24"
Fixed Costs	(Since no acre inch values were available in this study no calculations were made)							
Annual Dev. Cost Recovery			.17	.05	.17	.07	.19	----- (No bre down)
Annual Dev. Equip. Recovery			.11	.50	.47	.86	.33	-----
Other Fixed Costs			.49	.69	.78	1.99	.57	.70
Total Fixed Costs			.77	1.24	1.42	2.92	1.09	.70
Water Application Variable Costs			.72	1.11	.08	.13	.29	.40

TABLE .--CONT.

Total Water Application Costs			1.49	2.35	1.50	3.06	1.38	1.10
Other Variable Costs			2.61	2.55	2.28	3.60	2.13	2.90
Total Costs			$ 4.10	$ 4.90	$ 3.78	$ 6.66	$ 3.51	$ 4.00
Gross Returns			$ 7.00	$ 7.00	$ 6.10	$ 8.73	$ 8.27	$ 5.41
Remainder[a]			$ 2.90	$ 2.10	$ 2.32	$ 2.07	$ 4.76	$ 1.41

[a]Remainder is for land, labor, management and risk.

The remainder per acre is to pay for land, management, risk, and labor. Some of this remainder should pay for expected repairs to tillage equipment not charged as a cost to either the Harvey County demonstration farms and for repairs to harvesting equipment on the Eugene Wolf farm. With these adjustments in mind and the price and yield variance used for all items depending upon location, the reader can at least see what the range is for expected costs and returns under irrigation. No two operations are identical. Results must be adapted to specific situations.

3. Analysis Of Cost And Returns Data

McCoy, Buller, Orazem and Thomas in a 1966 study of profits from irrigation on Southwest Kansas farms, found some important total cost relationships dependent upon levels of production for corn silage and sorghum grain. They divided the farms by low, medium and high yields and arrived at costs for each. Costs and yields showed a positive correlation, as might be expected, with costs going up as production increased.76/

TABLE 30.--COST COMPARISONS BASED UPON YIELD LEVELS[a]

Crop	Low Yields		Medium Yields		High Yields	
	Yield	Total Cost	Yield	Total Cost	Yield	Total Cost
Corn Silage	20 T	$94.49	23 T	$99.29	26 T	$104.09
Sorghum Grain	80 Bu	46.88	100 Bu	48.88	120 Bu	50.88

[a]McCoy, Buller, Orazem and Thomas, How To Determine Relative Profitability of Selected Enterprises On Irrigated, Western Kansas Land.

A cost study is more relevant for management decision purposes when the marginal cost can be compared with the marginal returns. Price relationships as well as physical production determine marginal returns over marginal costs. There have not been many studies of marginal costs for irrigation in Kansas. The work by Sirohi and Nelson are notable exceptions. More work needs to be done in this line.

76/ McCoy, Buller, Orazem and Thomas, p. 8.

One example of analysis of marginal cost that has been done is shown in table 31.77/ It indicated that if at least 45 pounds of phosphorus per acre is added, costing $3.80 and that alfalfa hay is sold for $22 per ton; then, marginal returns ($15.12) about equal marginal costs of $14.00 for ten inches of irrigation water applied. It is interesting to note, however, that total returns from irrigation is above total costs when as much as forty inches of water is added if additional harvesting costs are not considered for irrigation over dryland. This study might suggest that when farmers apply high levels of water to their crops that they are spending more to get the last few bushels of grain or tons of feed than the returns would warrant.

Sirohi's analysis of economic optimum levels of water and nitrogen for grain sorghum at Garden City, Kansas is shown in table 32 under a three watering system.78/ He used a quadratic equation formula which seemed to fit the data better than either a Cobb-Douglas or linear equation. A similar study was done for alfalfa and wheat which is shown in tables 33 and 34.

Table 35 shows the relationship of "returns over variable costs of water due to economic optimum irrigation of grain sorghum at various prices of water and grain sorghums and at a crop season rainfall of 6.8 inches and previous moisture above 35 percent ASM - 3.4 inches at Garden City, Kansas."79/

77/ Loc. cit., Otto and Pine, p. 19, Table 12 & 14.

78/ Loc. cit., Sirohi, p. 89.

79/ Ibid., p. 98.

Trayer indicated from personal observation and experience with Southwest Kansas Farm Management Association irrigators that he felt Sirohi may have arrived at somewhat low water use levels for optimum returns. No such work has been done in recent years in South-Central Kansas, so there is no firm basis to establish optimum levels of water use in a normal year.

> "Good management practices (fertility, seeding rate, variety, row spacing and weed control) are necessary for high yields and efficient production. Sufficient water and a good irrigation system will not produce optimum yields unless good cultural practices are followed and sufficient fertilizer is added."80/

80/ M. E. Jensen and J. F. Musick, Irrigation Grain Sorghum, United States Department of Agriculture, Washington, D. C., Leaflet No. 511, 1962, p. 6.

TABLE 31.--MOST PROFITABLE WATER AND FERTILIZER AMOUNTS

ON ALFALFA 1954 IN SOUTH-CENTRAL KANSAS[b]

(Using 45 lb. P O - at $1.40 Cost Per Acre Inch of Water - $22 Hay)

INCHES OF WATER	AVERAGE YIELD (TONS) FERTILIZED	NON FERT.	DIFFERENCE	VALUE OF INCREASE	COST OF FERT.	DIFFERENCE	AVERAGE YIELD WATER AND FERTILIZED	DIFFERENCE OVER DRYLAND	VALUE INCREASE OVER DRYLAND	GAIN
DRYLAND							1.60	---	---	[a]
5	3.86	2.94	.92	$20.40	$3.80	$16.44	3.86	2.26	$49.72	$38.92
10	4.13	3.27	.86	19.82	3.80	15.12	4.13	2.53	55.66	34.06
15	4.40	3.60	.80	17.60	3.80	13.80	4.40	2.80	61.60	27.20
20	4.66	3.94	.72	15.84	3.80	12.04	4.66	3.06	67.32	24.32
25	4.92	4.27	.65	14.30	3.80	10.50	4.92	3.32	73.04	19.04
30	5.20	4.60	.59	12.98	3.80	9.18	5.20	3.60	79.20	14.40
35	5.45	4.94	.51	11.22	3.80	7.42	5.45	3.85	84.70	9.10
40	5.72	5.28	.44	9.68	3.80	5.88	5.72	4.12	90.64	4.24

[a]Increase of irrigated value minus fertilizer and water costs = gain over dryland.

[b]Amor Singh Sirohi, An Economic Analysis of Irrigation in Southwestern Kansas, a dissertation, Kansas State University, Manhattan, Kansas, 1962, p. 19.

TABLE 32.--RETURNS OVER VARIABLE COSTS OF WATER DUE TO ECONOMIC OPTIMUM IRRIGATION OF GRAIN SORGHUM AT VARIOUS PRICES OF WATER AND GRAIN SORGHUMS AND AT A CROP SEASON RAINFALL 6.8" AND PREVIOUS MOISTURE ABOVE 35% ASM = (3.4") - GARDEN CITY, KANSAS[a]

VARIABLE COST OF AN ACRE INCH OF WATER	RETURNS PER ACRE WITH GRAIN SORGHUM PRICED AT			
	70¢	80¢	90¢	$1.00
.40	26.29	31.22	35.91	40.59
.60	23.55	28.18	32.84	37.47
.80	20.75	25.30	29.89	34.49
1.00	18.13	21.21	25.71	30.23
1.20	15.66	19.11	24.48	28.87

NOTE: (If water cost $1 per acre inch and grain sorghum sold for $1 per bushel the optimum water use is 30 inches.)

[a]Sirohi, op. cit., p. 89.

TABLE 33.--ECONOMIC LEVELS OF WATER APPLICATION ON WHEAT - GARDEN CITY, KANSAS[a]

PRICE RATIO	SEPT. - NOV.	MARCH - APRIL	MAY	TOTAL
.2	10.2	7.8	6.2	24.2
.3	10.1	7.6	6.1	23.8
.4	10.0	7.4	6.0	23.4
.5	9.9	7.2	5.9	23.0
.6	9.7	6.9	5.8	22.4

[a]Sirohi, op. cit., p. 90.

TABLE 34--ECONOMIC OPTIMUM LEVELS OF WATER APPLICATION ON ALFALFA - GARDEN CITY, KANSAS[a]

PRICE RATIO	JUNE	JULY	AUGUST	TOTAL
.03	12.8	20.9	15.4	49.1
.04	12.5	19.7	13.9	46.1
.05	12.2	18.6	12.4	43.2
.06	11.9	17.4	10.9	40.2

[a]Sirohi, op. cit., p. 91.

TABLE 35.--ECONOMIC OPTIMUM LEVELS OF WATER AND NITROGEN FOR GRAIN SORGHUM AT CURRENT PRICES WITH VARIOUS RATIOS OF WATER AND YIELD, GARDEN CITY, KANSAS, 1962[a]

ACRE INCH/BUSHEL PRICE RATIO	JUNE	JULY	AUGUST	NITROGEN POUNDS
.5	8.7	16.2	4.7	75.3
.6	8.7	15.5	4.6	75.2
.7	8.7	14.9	4.5	75.0
.8	8.7	14.3	4.4	74.8
.9	8.6	13.7	4.3	74.6
1.0	8.6	13.1	4.3	74.5
1.1	8.6	12.5	4.3	74.3
1.2	8.6	11.8	4.2	74.2
1.3	8.6	11.2	4.1	74.0

NOTE: If water costs $1 per acre inch and grain sorghum sells for $1 per bushel or where the ration was 1.0 then the optimum June water application was 8.6 acre inches, July 13.1 acre inches, and August 4.3 acre inch with a level of 74.5 pounds of nitrogen applied.

[a]Sirohi, op. cit., p. 98.

CHAPTER III

COSTS AND RETURNS FROM PRODUCTION ON IRRIGATED LAND IN THE ELEVEN-COUNTY AREA

With the help of several Farm Management Association members in South-Central Kansas, a group study was made on costs and returns of irrigation. Detailed records were kept by these members. Because of the use of some pieces of equipment for both dryland and irrigated operations, certain costs had to be figured on a weighted use basis to obtain cost for irrigation. Table 36 indicates that study farms *included 6.11 percent of the total irrigated acreage in the eleven-*county area.

Data for this study were taken from 28 farms in 1968 and 19 in 1969. Fourteen farms were included in both the 1968 and 1969 studies. Of the total 79,801 acres irrigated in the eleven counties, the study included 3,725 acres in 1968 and 3,221 acres in 1969, or 4.67 and 4.03 percent of the total irrigated acres in respective years. It is generally recognized that the Farm Management farms are above average in efficiency and size. This would cause the reader to expect somewhat lower overall average net gains if all farms were studied in detail. It has been subjectively observed that Farm Management Association farms generally set the pace for future trends in agriculture. This is particularly observed in adoption of technology, crop yields and size of farm. It is less true for net returns and costs.

Costs were split into variable and fixed costs. Costs included

under variable were hired labor, fertilizer, seed and crop expense, utilities, dues and fees, fuel and oil, auto, machine hire, machine repair, and home raised seed. Total fixed costs include depreciation on machinery, interest on investment, insurance, and personal property taxes. Total variable costs and total fixed costs were added to arrive at total costs. No charge was made for land, operator labor or management. All of these farms were using flood irrigation with the exception of two toe-line sprinkler systems being used on a total of 78 acres.

Very little land leveling was done on these farms in 1968 or 1969. To be consistent with income tax regulations, the costs of land leveling are included and are reflected in the variable cost factors of machine hire if it was hired and under fuel and oil, repairs, and the fixed cost factor of depreciation on equipment and interest on investment in machinery if done by the operator. This method of accounting assigns the land leveling portion of investment to variable cost for the year in which leveling occurred. However, for the farms considered here it was a relatively negligible cost (less than 49¢ per acre in 1968 and $2.00 per acre in 1969). Variable costs are only slightly overstated and annual fixed costs slightly reduced.

Where certain machines were used both on dryland and irrigated fields the farmer was asked to report the number of acres and number of times the machine was used on each field. From this information an allocation of such costs as depreciation, repairs, and interest on investment was made. Farm fuel was allocated on the basis of the same

information. All other irrigation costs were specifically pulled out of the total farm expenses and charged to the irrigation operation.

All irrigation equipment costs are included along with the tillage and harvesting equipment to arrive at equipment costs.

TABLE 36.--A COMPARISON OF SELECTED CROPS IRRIGATED IN THE AREA WITH THE STUDY FARMS IRRIGATED CROPS, 1968[a]

CROP	AREA		STUDY FARMS	
	Crop Acres	Irrigated Acres	Irrigated Acres	% of Total Area Irrigated Acres
Grain Sorghum	427,000	18,800	1,000	5.32
Wheat	2,516,000	6,000	454	7.56
Forage Sorghum	116,300	16,070	175	1.05
Corn	40,400	14,420	1,748	12.12
TOTAL	3,099,700	55,290	3,377	6.11

[a]Farm Facts 1968-1969 and Kansas County Agents Reports - 1968.

A. PRODUCTION COSTS AND RETURNS - GROUP STUDY

1. Variable Costs Associated With Flood Irrigation

Total variable costs for 1968 on the 28 Farm Management Association farms for all irrigated crops grown, averaged $45.76 counting home raised seed; but not including operators labor. Variable costs made up 72.6 percent of total costs. Total variable costs per acre inch of water pumped was $2.08 where an average of 21.84 acre inches per acre was pumped.

Gross returns were figured from actual production at current prices at time of sale or as of January 1. The total gross from irrigation was $390,384 total operating expenses were $236,045 and total net was $154,339 to land, labor and management.

Twenty-two percent of all land cultivated on the study farms was irrigated in 1968. The average acres cultivated per farm was 611, although nine farms cultivated under 350 acres and six were farming over 900 acres. Table 38 shows the gross return per acre for all crops grown on irrigated land. There was no attempt made to figure costs of individual crops in 1968.

In 1969 a similar study of 19 Farm Management Association farms was conducted. The gross from these 19 farms from irrigation was $363,757 and all expenses except operators return for labor and management, land taxes and a return to land investment, totaled $218,269. This left a net to distribute to the above factors of $145,480. The costs for 1969 are shown in Table 39.

The returns from the 19 farm study of Farm Management Association irrigation farms in 1969 are shown in table 40. The gross per irrigated acre was $115.66. The net for labor, management, land and land taxes was $45.16 per acre irrigated.

TABLE 37.--IRRIGATION COST PER ACRE ON 28 SOUTH-CENTRAL KANSAS FARM, 1968

COSTS	PER ACRE	% OF TOTAL
Variable Costs		
Hired Labor	$ 2.76	4.2
Fertilizer	14.89	23.6
Seed and Crop Expense	5.60	8.6
General Utilities	.71	1.1
Dues and Fees	.37	.6
Fuel and Oil - Total	5.28	8.2
Auto	.90	1.3
Machine Repair	5.96	9.8
Home Raised Seed	.15	.4
Machine Hire	9.14	14.8
TOTAL VARIABLE COSTS	$45.76	72.6%
Fixed Costs		
Insurance and Personal Property Taxes	$ 1.14	1.6
Interest on Investment in Machinery	3.97	6.2
Depreciation - Machinery	12.27	19.6
TOTAL FIXED COSTS	$17.38	27.4%
TOTAL COSTS (No land, operator labor, or management costs included)	$63.14	100%

TABLE 38.--RETURNS FROM IRRIGATED ACREAGE ON 28 FARM MANAGEMENT ASSOCIATION FARMS IN SOUTH-CENTRAL KANSAS, 1968

No. Farms	Crops	Total Acres	Av. Acres Per Farm	Total Production	Yield Per Acre	Av. Gross Per Acre
12	Corn	982	81	109,924	111.8	$115.11
15	Grain Sorghum	1,000	66	78,672	78.7	74.50
5	Wheat (No Cert.)	454	90	17,490	38.0	45.44
9	Alfalfa	215	23	856	4.2	101.04
6	Soybeans	133	22	3,521	26.6	62.00
14	Corn Silage	766	54.1	13,523T	17.5T	133.69
5	Sorghum Silage	175	35	2,845T	16.3T	112.22
5	Wheat Certificate	454	90			14.25
17	Feed Grain Pay.	2,046	120			12.16
1	Ins., Damages, etc.					

TABLE 39.--IRRIGATION COST PER ACRE ON 19 SOUTH-CENTRAL KANSAS FARMS, 1969

COSTS	PER ACRE	% OF TOTAL
Variable Costs		
Hired Labor	$ 2.89	4.2
Fertilizer	17.13	24.5
Seed and Crop Expense	8.29	11.9
General Utilities	1.17	1.6
Dues and Fees	.69	.9
Fuel and Oil-Total	4.77	6.8
Auto	.98	1.4
Machinery Repair	6.06	8.7
Machine Hire	6.73	9.7
Home Raised Seed	.31	.4
Total Variable Costs	$49.02	70.2%
Fixed Costs		
Insurance and Personal Property Tax	$ 1.49	2.2
Interest on Investment on Machinery	3.37	4.8
Depreciation on Machinery	15.85	22.8
Total Fixed Cost	$20.71	29.8%
Total Costs	$69.73	100 %

TABLE 40.--RETURNS FROM IRRIGATED ACREAGE
ON 19 FARM MANAGEMENT ASSOCIATION
FARMS IN SOUTH-CENTRAL KANSAS, 1969

NO. OF FARMS	CROP	GROSS	TOTAL ACRES	AV. ACRES PER FARM	TOTAL PRODUCTION	YIELD PER ACRE	AV. GROSS PER ACRE
10	Corn Grain	$129,861	985	98.5	110,159Bu	111.84	$131.84
13	Sorghum Grain	81,363	866	66.6	81,513Bu	94.12	93.95
4	Wheat	3,239	78	19	2,666Bu	34.18	41.52
3	Alfalfa	7,223	84	28	314T	3.73T	85.99
6	Soybeans	15,742	187	31	7,208Bu	38.55	84.18
11	Corn Silage	81,384	757	68.8	10,563T	13.95T	107.51
2	Sorghum Silage	16,182	150	75	2,697T	17.98T	107.88
1	Wheat Cert.	140	10	---	----	----	14.00
11	Feed Grain Pay.	24,198	1,672	---	----	----	14.47
1	Potatoes	8,623	72	72	4,023ct.	55.8ct.	119.76
1	Barley	1,403	37	37	1,754Bu	48	37.92
1	Sudan	250	5	5	25T	5T	25.00

A more detailed and specific study of costs and returns for corn grain and silage on irrigation farms is summarized in table 41. A detailed cost and return study of irrigated grain sorghum is shown in table 42. These were small samples, but they are illustrative of what is actually being done on farms in the eleven-county area with flood irrigation. These farms were some of the 19 farms in the previous study. In 1969 a study was made of three farms whose only irrigated crop was grain sorghum. It revealed that total variable costs were $46.70 per acre or $3.79 per acre inch of water pumped. The same year a study of six farms irrigating corn only, revealed that variable costs were $46.01 per acre or $2.52 per acre inch of water applied. Rainfall was above normal in 1969, so less water was pumped than would be in other years. This probably accounted for a large part of the higher cost per acre inch pumped.

TABLE 41.--PRODUCTION COSTS AND RETURNS UNDER IRRIGATION FOR CORN GRAIN AND SILAGE FOR SELECTED SOUTH-CENTRAL KANSAS FARM, 1969

COSTS	PER ACRE	% OF TOTAL
VARIABLE COSTS		
Hired Labor	$ 2.51	3.6%
Fertilizer	22.39	32.3
Seed and Crop Expense	7.58	10.9
General Utilities	1.37	1.9
Dues and Fees	.39	.6
Fuel and Oil - Total	4.10	5.9
Auto	.43	.6
Machine Repair	4.82	6.9
Home Raised Seed	---	---
Machine Hire	2.42	3.5
TOTAL VARIABLE COSTS	$46.01	66.5%
FIXED COSTS		
Insurance and Personal Property Taxes	$ 1.52	2.1%
Interest on Investment on Machinery	5.56	8.0
Depreciation - Machinery	16.19	23.4
TOTAL FIXED COSTS	$23.27	33.5%
TOTAL COSTS (No Land, Operator Labor or Management Costs Are Included)	$69.28	100%

6 FARMS -- MOSTLY CORN UNDER IRRIGATION FARMS

Total Acres Corn - 986 Acres

Total Acres Corn Grain - 714 Acres

Total Acres Other Irrigated Crops - 31 Acres

Gross From All Irrigated Crops - $133,692

Gross From Corn Irrigated - $130,515

Gross From Corn Grain Only - $98,900

Average Gross Per Acre On Corn - $132.37

Average Gross Per Acre Corn Grain - $138.51

Average Gross Per Acre Corn Silage - $116.23

TABLE 42.--PRODUCTION COSTS AND RETURNS FOR GRAIN SORGHUM 1969 BARTON AND STAFFORD COUNTIES SELECTED IRRIGATION FARMS

COSTS	PER ACRE	% OF TOTAL
VARIABLE COSTS		
Hired Labor	$ 3.54	3.6%
Fertilizer	17.93	28.9
Seed and Crop Expense	6.00	9.3
General Utilities	.69	.1
Dues and Fees	1.79	2.7
Fuel and Oil - Total	7.17	11.1
Auto	1.10	1.7
Machine Repair	6.73	10.4
Home Raised Seed	---	---
Machine Hire[a]	1.75	2.7
TOTAL VARIABLE COSTS	*$46.70*	*72.5%*
FIXED COSTS		
Insurance and Personal Property Taxes	$ .95	.2%
Interest on Investment on Machinery	3.98	6.1
Depreciation - Machinery	13.17	21.2
TOTAL FIXED COSTS	$18.10	27.5%
TOTAL COSTS (No Land, Operator Labor, or Management Costs Are Included)	$64.80	100 %

[a]$532] *of leveling costs were* not included since on this same sample it would change the total a great deal and this is not an every year cost.

3 FARMS - ONLY IRRIGATED CROP GRAIN SORGHUM

Total Acres - 2,124

Total Acres Grain Sorghum - 347

Total Bushels Grain Sorghum - 38,300

Gross From Grain Sorghum - $38,300

(No Feed Grain Payments)

Average Per Acre Produced = 110.37 Bu.

Average Gross Per Acre = $110.37

B. CASE STUDY FARMS

In addition to the larger sample, four farms with representative irrigation systems were selected as case studies to obtain more detailed financial records. These case study farms were used to illustrate an analysis procedure that individual farmers may use in budgeting, making forward cash flow projections and determining return on investment.

The case study farms were considered representative of well managed irrigation operations in the area by the Farm Management Association field men working with them. The operating costs and investment incurred by the case study farms were representative of those considered necessary and adequate for above average production under irrigation conditions. In the years studied, the operations produced equal to or above the average for irrigated crops in their respective counties. From a costs standpoint, the case study farms are considered representative with the possible exception of lower than average development costs; but the average farm in the eleven-county area probably would not obtain yields as high as were obtained on the case study farms. These farms had very detailed cost and return records available.

Two of the case studies are examples of flood irrigation. On the basis of observation and cross comparison with the other farms included in the 1968 and 1969 irrigation study of 28 and 19 farms respectively; it would appear that these two farms are representative of Farm Management Association irrigation farms and what is happening with respect to cash flows. Case study number two with flood irrigation and case study number four with sprinkler irrigation are on the

same farm unit. Some similarity of cash flow habits will thus be observed between these two study units.

A group sampling of farms with center-pivot sprinkler irrigation systems with a meaningful number of representative operations was unobtainable from records of Farm Management Association members in South-Central Kansas.

The case study approach was used to supply some representative cost and returns data. Data from case study farms number three and number four are shown in table 59 and table 60. Both of these operations were in the first year and were in a learning phase.

1. Development Costs And Equipment Costs For Flood Systems

The case study farms are used to illustrate the expected development costs for irrigation in South-Central Kansas. All have relatively shallow wells.

a. Development Costs

(1) Case Study Number One

This farm has three irrigation wells. One was drilled in 1964 and the other two in 1968. A tail water system was added to the 1964 development in 1968. The water levels are between 20 and 30 feet. Wells number one and two had lower development cost per acre because the operator did his own leveling on the first two. This farmer purchased dirt moving equipment which is considered a development cost here. The fixed development costs are outlined in table 43 for each well.

TABLE 43.--CASE STUDY NO. 1 DEVELOPMENT COSTS

Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
	(Well number 1) 160 Acres		
1. Well-75 feet & Gravel Packed	1-10-64	$1,176	$ 7.35
2. Land Plane (Used own labor and tractor to level)	1-10-64	1,528	9.52
	Total	$2,704	$16.87
	(Well number 2) 154 Acres		
1. Well-75 feet & Gravel Packed	7-4-68	$1,281	$ 8.31
2. Soil Mover (Used own labor and tractors to level)	1-7-68	$1,133	7.36
	Total	$2,414	$15.67
	(Well number 3) 150 Acres		
1. Well-75 feet Gravel Packed	1968	$1,300	$ 8.66
2. Leveling costs- (Hired a contractor to level)	1968	7,318	48.78
	Total	$8,618	$57.44

(2) Case Study Number Two

This farm drilled two wells in 1968 to a depth of 47 feet with the static water level at 10 feet. The pumping capacity of the wells is 1100 gallon per minute each. Land leveling was hired. It needed relatively little leveling compared with many potential irrigation operations in the study area.

TABLE 44.--CASE STUDY NO. 2 DEVELOPMENT COSTS

Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
1. Well-47 feet & Gravel Packed	7-1968	$1,772	$17.72
2. Land Leveling	6-1968	2,709	27.09
Totals		$4,481	$44.81

b. Initial Equipment Costs

(1) Case Study Number One

Gated-pipe flood systems are in use on the farm. The wells have turbine pumps and liquid petroleum fuel motors. Table 45 shows the initial equipment costs for each of the three wells.

The wide differences that are exhibited on a per acre basis for both the development and initial equipment costs were due to differences in amount of irrigation pipe used.

TABLE 45.--CASE STUDY NO. 1 INITIAL EQUIPMENT COSTS

	Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
1.	Gear head and Turbine Pump	1-10-64	$ 2,108	$ 13.17
2.	M & M Motor	1-10-64	1,861	11.63
3.	Irrigation Pipe	1-10-64	11,487	71.79
		1- 9-65	1,874	11.71
4.	Transet Level	1- 8-67	121	.76
5.	*Tailwater Pump*	1- 6-68	250	1.53
		Totals	$17,701	$110.59
		(Well number 2) 154 Acres		
1.	Pump and Motor	7- 4-68	$ 2,600	$ 16.88
2.	Pipe	7- 4-68	4,442	28.84
3.	Fertilizer	1- 4-68	463	3.00
		Total	$ 7,505	$ 48.72
		(Well number 3) 150 Acres		
1.	Pump, Motor and Pipe	1968	$12,504	$ 83.36

(No breakdown available since it is a rented farm and these figures were known by the operator as a lump sum.)

(2) Case Study Number Two

This system has two turbine pumps that can be tied together with surface aluminum pipe. They are powered by electric motors with a rated 15 horsepower each. The wells water 100 acres of land.

TABLE 46.--CASE STUDY NO. 2 INITIAL EQUIPMENT COSTS

(100 acres)

	Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
1.	Pumps	7-68	$1,900	$19.00
2.	Pipe & Electric Motor Convertor	7-68	2,596	25.96
3.	Pipe	2-68	2,607	26.07
4.	Pipe	6-65	2,073	20.73
		Total	$9,176	$91.76

c. Total Investment

The total investment in each of the two case study farms are shown in the tables 47 and 48.

It can be concluded from these data that flood irrigation development costs vary greatly. The range in cost in South-Central Kansas for the four examples cited is from $15.67 to $57.44. Development costs will tend to be lower in South-Central Kansas than in some other areas due to shallower wells. A drilled well in the eleven-county area cost $16 to $18 per foot when gravel packed. The amount of land leveling necessary and the well depth are the main cost variables.

The initial equipment costs varied from $48.72 to $110.59 per acre in the South-Central Kansas case studies. The major variable cost between one case study and another is the number of feet of surface irrigation pipe necessary to water the unit successfully. The pumps and motors also vary in cost, but tend to have less influence on the per acre cost than differences in pipe required. The average cost for a turbine pump for 1000 gallon per minute with a lift of 40 feet was $1600 to $1700 plus a gearhead cost of $1000. These costs are for equipping fuel power plants, rather than electric.

(1) Case Study Number One

TABLE 47.--TOTAL INVESTMENT

Cost Factor	Year of Purchase	Original Cost	Cost Per Acre
	(Well number 1) 160 acres		
1. Development	1964	$ 2,704	$ 16.87
2. Equipment	1964-68	17,701	110.59
	Total	$20,405	$127.46
	(Well number 2) 154 acres		
1. Development	1968	$ 2,414	$ 15.67
2. Equipment	1968	7,505	48.72
	Total	$ 9,919	$ 64.39
	(Well number 3) 150 acres		
1. Development	1968	$ 8,618	$ 57.44
2. Equipment	1968	12,504	83.36
	Total	$21,122	$140.80

(2) Case Study Number Two

TABLE 48.--TOTAL INVESTMENT

Cost Factor	Year of Purchase	Original Cost	Cost Per Acre
1. Development	1968	$ 4,481	$ 44.81
2. Equipment	1968	9,176	91.76
	Total	$13,657	$136.57

2. Development Costs And Equipment Costs For Sprinkler Systems

a. Development Costs

(1) Case Study Number Three

This farm developed irrigation with a center-pivot sprinkler in 1969 for about 130 acres. The well was 80 feet deep with the static water standing at 15 feet from the surface. It was on sandy soil with a few low, poorly drained clay pockets. No land forming has been done yet.

TABLE 49.--CASE STUDY NO. 3--DEVELOPMENT COSTS--
RICE COUNTY KANSAS--CENTER-PIVOT SPRINKLER SYSTEM
(130 acres)

Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
1. Well	6-69	$1,320	$10.15

(2) Case Study Farm Number Four

This is the same farm from which case study number 2 was made. It was developed for center-pivot sprinkler irrigation in 1970 and is located adjacent to the flood irrigation field in case study number 2. The well is rated at 1300 gallon per minute, but pumps 850 gallon per minute to the sprinkler. It is drilled to a depth of 79 feet. The development cost information is in table 50. The system waters 130 acres. There was $20.99 per acre spent for leveling on this system.

TABLE 50.--CASE STUDY NO. 4--DEVELOPMENT COSTS--
SEDGWICK COUNTY KANSAS--CENTER-PIVOT SPRINKLER
(130 acres)

Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
1. Well	6-70	$ 1,264	$ 9.72
2. Leveling	5-70	2,729	20.99
	Total	$ 3,993	$30.71

b. Initial Equipment Costs

(1) Case Study Number Three

This system has a liquid petroleum power unit and a turbine pump. It is rated at 900 gallons per minute. The equipment costs are outlined in table 51.

This farm obtained a used motor and rebuilt it at a savings over a new engine. The sprinkler system was purchased at about 12% below list price.

TABLE 51.--CASE STUDY NO. 3--INITIAL EQUIPMENT COSTS--
RICE COUNTY KANSAS--CENTER-PIVOT SPRINKLER SYSTEM
(130 acres)

Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
1. Pump	6-69	$ 1,780	$ 13.69
2. Used Engine	6-69	450	3.46
3. Rebuild Engine	9-69	1,114	8.56
4. Sprinkler	7-69	16,980	130.61
	Total	$20,324	$156.32

(2) Case Study Number Four

This system is probably the most representative of equipment costs of the two for the study area.

The engine, pump and sprinkler cost more than did similar items in case study number three. Prices are still under list prices given by most dealers.

TABLE 52.--CASE STUDY NO. 4--INITIAL EQUIPMENT COSTS FOR CENTER-PIVOT SPRINKLER--SEDGWICK COUNTY, KANSAS, 1968

Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
1. Pump	6-70	$ 2,773	$ 21.33
2. Engine	5-70	2,421	18.62
3. Sprinkler	5-70	19,323	148.61
	Total	$24,517	$188.56

c. Total Investment Costs

These two case studies had costs of $10.15 and $30.71 per acre for development and $156.32 and $188.56 per acre for initial equipment costs, respectively. Costs differed dependent upon well depths and the price of the equipment chosen. These costs are shown in table 53 and table 54.

(1) Case Study Number Three

TABLE 53.--TOTAL INVESTMENT COSTS
(130 acres)

Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
1. Development	1968	$ 1,320	$ 10.15
2. Equipment	1969	20,324	156.32
	Total	$21,644	$166.47

(2) Case Study Number Four

TABLE 54.--TOTAL INVESTMENT COSTS
(130 acres)

Cost Factor	Date of Purchase	Original Cost	Cost Per Acre
1. Development	1970	$ 3,992	$ 30.71
2. Equipment	1970	24,517	188.56
	Total	$28,510	$219.27

2. Annual Costs And Returns From Case Study Farms

Individual cost and return analysis on an annual basis was done for each of the flood irrigation case farm examples for 1968 and 1969. Similar analysis was done for the flood irrigation case farms for 1970. A comparison of costs for all crops and irrigated crops only is given for each case study farm. The returns reported are for irrigation production only on the farms. A correction for custom work done off farm is made. The total custom work payment to the farm and to the irrigation enterprise is reduced by ten percent to reflect the operators labor cost.

a. Flood Irrigation Case Studies

(1) Case Study Number One

Table 55 shows the 1968 costs and returns and table 56 gives the 1969 cost and returns data for case study farm number one. The net of $36.08 per acre for 1968 and $64.43 per acre for 1969 reflects a combination of lower annual costs and higher production for 1969 over 1968. The net income is a residual figure to pay operator labor, management, and land a return. The return for operator labor, management and land in 1968 was below the amount that would generally be considered adequate for the time and investment involved. The $36.08 net return per acre in 1968 would have given a return of four percent on $400 land and about $2.60 per hour of labor. In contrast a six percent return to $400 land could have been paid in 1969 plus $4.04 per hour of labor. A labor requirement of ten hours per acre is used for both years.

TABLE 55.--ANNUAL COST AND RETURN ANALYSIS

FOR CASE STUDY NO. 1, 1968

	COSTS	ALL CROPS	IRRIGATED TOTAL	IRRIGATED PER ACRE
	Variable Costs			
1.	Hired Labor	$ 3,639	$ 3,371	$10.03
2.	Fertilizer and Lime	10,260	5,039	14.99
3.	Seed and Crop Expense	4,486	4,460	13.27
4.	General Utilities	200	----	----
5.	Dues and Fees	175	4	.02
6.	Fuel and Oil for Pumping	-----	183	.54
7.	Fuel and Oil for Other Machinery	2,600	1,422	4.23
8.	Auto Share	400	----	----
9.	Machinery Repair	3,700	408	1.21
10.	Machine Hire	8,798	3,795	11.29
11.	Home Raised Seed	567	----	----
	Total Variable Costs	$ 34,825	$18,682	$55.60
	Fixed Costs			
12.	Machinery Depreciation	$ 11,303	$ 7,000	$20.83
13.	Insurance and Taxes	944	190	.56
14.	Crop Building Costs	569	169	.50
15.	Interest on Investment All Machinery	3,197	1,738	5.18
	Total Fixed Costs	$ 16,013	$ 9,097	$27.07
16.	Custom Work Correction	(-1,742)	(-1,742)	(-5.17)
	TOTAL	$ 49,096	$26,037	$77.50

	GROSS	ACRES	BUSHELS PER ACRE
Corn	20,799	196	113.5
Milo	3,511	42	90.2
Soybeans	944	20	20.8
Silage	9,608	78.2	20
Payments	3,308		
	$38,162	336	

GROSS = 38,162
EXP. = 26,037
NET = 12,125

GROSS PER ACRE = $113.58
NET PER ACRE = $ 36.08

TABLE 56.--ANNUAL COST AND RETURN ANALYSIS

FOR CASE STUDY NO. 1, 1969

	COSTS	ALL CROPS	IRRIGATED TOTAL	IRRIGATED PER ACRE
	Variable Costs			
1.	Hired Labor	$ 2,375	$ 1,159	$ 3.48
2.	Fertilizer and Lime	8,319	6,175	18.54
3.	Seed and Crop Expense	5,650	4,136	12.42
4.	General Utilities	346	20	.06
5.	Dues and Fees	157	60	.18
6.	Fuel and Oil for Pumping	3,159	412	1.24
7.	Fuel and Oil for Other Machinery	For Both	1,102	3.31
8.	Auto Share	----	----	----
9.	Machinery Repair	3,862	1,800	5.40
10.	Machine Hire	6,116	2,316	6.95
11.	Home Raised Seed	910	----	----
	Total Variable Costs	$30,894	$17,180	$51.59
	Fixed Costs			
12.	Machinery Depreciation	$16,401	$ 7,165	$21.51
13.	Insurance	717	----	----
14.	Crop Building Costs	----	----	----
15.	Interest on Investment All Machinery	----	2,260	6.79
	Total Fixed Costs	$17,118	$ 9,425	$28.30
16.	Custom Work Correction	(-1,940)	(-1,400)	(-4.20)
	TOTAL	$46,072	$25,205	$75.69

PRODUCTION	ACRES	TOTAL YIELD	AV. YIELD	VALUE
Corn Grain	216	24,788 Bu.	114	27,267
Silage Corn	117	1,638	14T	13,104
Feed Grain Pmt.				6,288
	333		TOTAL GROSS	$46,659
NET = $21,454			GROSS PER ACRE	= $140.12
			NET PER ACRE	= $ 64.43

(2) Case Study Number Two

Annual costs and returns for case study number two for 1968 and 1969 are reviewed in table 57 and table 58. The costs per acre on this irrigation unit were $109.66 in 1968 and $98.27 in 1969. This unit was smaller than case study number one. Number two had costs per acre that were higher than the $77.49 per acre in 1968 and $75.69 per acre in 1969 for case study number one. Case study number two had much higher production and in turn a higher gross and net per acre.

The net of $30.50 per acre for 1968 for case study number two gave a four percent return to $400 land and $1.45 per hour of operator labor in 1968. The $77.70 net per acre in 1969 gave a six percent return to $400 acre land and $5.37 per hour of operator labor when both years are combined. This gives a very competitive return to these two factors in light of other studies of both irrigation and dryland farming by the author and others in the eleven-county area.

TABLE 57.--ANNUAL COST AND RETURN

ANALYSIS FOR CASE STUDY NO. 2

1968

	COSTS	ALL CROPS	IRRIGATED TOTAL	IRRIGATED PER ACRE
	Variable Costs			
1.	Hired Labor	$ 2,903	$ 920	$ 9.20
2.	Fertilizer and Lime	6,905	2,879	28.79
3.	Seed and Crop Expense	2,212	251	2.51
4.	General Utilities	354	15	.15
5.	Dues and Fees	190	----	----
6.	Fuel and Oil for Pumping	----	197	1.97
7.	Fuel and Oil for Other Machinery	1,352	390	3.90
8.	Auto Share	395	130	1.30
9.	Machinery Repair	2,693	890	8.90
10.	Machine Hire (Leveling)	3,646	2,709	27.09
11.	Home Raised Seed	550	----	----
	Total Variable Costs	$21,200	$8,381	$ 83.81
	Fixed Costs			
12.	Machinery Depreciation	$ 5,985	$2,000	$ 20.00
13.	Insurance	452	----	----
14.	Crop Building Costs	----	----	----
15.	Interest on Investment All Machinery	1,982	585	5.85
	Total Fixed Costs	$ 8,419	$2,585	$ 25.85
16.	Custom Work Correction	----	----	----
	TOTAL	$29,619	$10,966	$109.66

	GROSS	ACRES	BUSHELS PER ACRE
Corn	$14,010	100	154

GROSS = 14,016
EXP. = 10,966
NET = 3,050

GROSS PER ACRE = $140.16
NET PER ACRE = $ 30.50

TABLE 58.--ANNUAL COST AND RETURN

ANALYSIS FOR CASE STUDY NO. 2

1969

	COSTS	ALL CROPS	IRRIGATED TOTAL	IRRIGATED PER ACRE
	Variable Costs			
1.	Hired Labor	(Was not	$ 630	$ 6.30
2.	Fertilizer and Lime	available)	2,024	20.24
3.	Seed and Crop Expense		1,471	14.71
4.	General Utilities		20	.20
5.	Dues and Fees		----	----
6.	Fuel and Oil for Pumping		210	2.10
7.	Fuel and Oil for Other Machinery		271	2.71
8.	Auto Share		----	----
9.	Machinery Repair		519	5.19
10.	Machine Hire		632	6.32
11.	Home Raised Seed		----	----
	Total Variable Costs		$5,777	$57.77
	Fixed Costs			
12.	Machinery Depreciation		$2,900	$29.00
13.	Insurance		150	1.50
14.	Crop Building Costs		100	1.00
15.	Interest on Investment-All Machinery		900	9.00
	Total Fixed Costs		$4,050	$40.50
16.	Custom Work Correction		----	----
	TOTAL		$9,827	$98.27

PRODUCTION	ACRES	TOTAL YIELD	AV. YIELD	VALUE
Corn	100	14,664 (15% Moisture)	146.4	$17,597

GROSS = $17,597
EXPENSE = 9,827
NET = 7,770

GROSS PER ACRE = $175.97
NET PER ACRE = $ 77.70

b. Center-Pivot Irrigation Case Studies

(1) Case Study Number Three

Table 59 shows the 1970 costs and returns data for case study farm number three. The gross per crop acre of $108.20 was the lowest of any of the case farm examples. This was due to a slightly lower than average bushels per acre of irrigated grain sorghum and the fact that grain sorghum was a lower value crop than corn in the South-Central Kansas area. The net income per acre of $26.75 for land, operator labor and management was lower than any of the other case study farms except farm number one in 1968 which was $25.72.

Case study farm number three is in a learning period which probably accounts for the lower than desired net income per acre.

The land on this farm was purchased before irrigation development in 1969 at a cost of $362 per acre. A four percent annual return on this land equals $14.48. Using the labor requirement cited for the Clinton Holdeman farm of 5.85 hours per acre the return to operator's labor and management equals $11.24 or $1.92 per hour. This farm was rented on the basis of a one-third crop share to the owner. The landlord share was $32.78 per acre. The operator after his total costs lost $6.03 per acre and received nothing for his labor. His lack of irrigation experience probably hurt his profits.

TABLE 59.--ANNUAL COST AND RETURN

ANALYSIS FOR STUDY NO. 3, 1970[a]

	COSTS	IRRIGATED TOTAL	IRRIGATED PER ACRE
	Variable Costs		
1.	Hired Labor	$ 20	$ .15
2.	Fertilizer & Lime	2,409	18.53
3.	Seed & Crop Expense	2,891	22.24
4.	General Utilities	25	.19
5.	Dues & Fees	40	.31
6.	Fuel & Oil for Pumping	736	5.66
7.	Fuel & Oil for Other Machinery	----	----
8.	Auto Share	63	.48
9.	Machinery Repair	98	.75
10.	Machine Hire	94	.72
11.	Home Raised Seed	----	----
	Total Variable Costs	$ 6,376	$49.03
	Fixed Costs		
12.	Machinery Depreciation	$ 2,633	$20.25
13.	Insurance	----	----
14.	Crop Building Costs	----	----
15.	Interest on Investment-All Machinery	1,579	12.15
	Total Fixed Costs	$ 4,212	$32.40
16.	Custom Work (Minus)	----	----
	TOTAL	$10,588	$81.43

PRODUCTION	ACRES	TOTAL YIELD	AV. YIELD	VALUE
Grain Sorghum	130	12,090 Bu.	93 Bu.	$13,299
Rye Pasture	(130)	(double crop)		765
	130		TOTAL GROSS	= $14,066
			GROSS PER ACRE	= $108.20
			NET PER ACRE	= $ 26.77

[a]All crops were irrigated.

b. Case Study Number Four

Table 60 shows the 1970 costs and returns data for case study farm number four. The gross per acre of $167.12 in 1970 was next to the highest of all the case study operations for 1968, 1969 and 1970. This seemed to be due to a high yield of corn with a relatively good price per bushel.

The net of $57.60 per acre was very competitive with the other case farm examples studied. The land was valued at $400 per acre. At a four percent annual return the net for land equals $16.

This left $41.60 per acre for labor and management. Using the Clinton Holdeman 5.85 hours per acre irrigated standard there is a return of $7.11 per hour of labor.

The corn produced on case study farm number four sold for $1.41 per bushel compared to $1.10 per bushel for the milo on case study farm number three. A combination of more irrigation management experience, a higher-value crop, and higher production per acre on case study farm number four resulted in a better return. This was true even though the total costs per acre were $109.40 for case study number four and $81.45 for case study number three. These costs are before return to land and operator labor is computed. The two case study farms will be discussed in greater detail in cash flow analysis in the next section of the report.

TABLE 60.--ANNUAL COST AND RETURN

ANALYSIS FOR STUDY NO. 4, 1970[a]

COST	IRRIGATED TOTAL	IRRIGATED PER ACRE
Variable Costs		
1. Hired Labor	$ ----	$ ----
2. Fertilizer & Lime	2,674	20.57
3. Seed & Crop Expense	1,994	15.34
4. General Utilities	----	----
5. Dues & Fees	----	----
6. Fuel & Oil for Pumping	841	6.47
7. Fuel & Oil for Other Machinery	----	----
8. Auto Share	----	----
9. Machinery Repair	482	3.71
10. Machine Hire	2,794	21.49
11. Home Raised Seed	----	----
Total Variable Costs	$ 8,785	$ 67.58
Fixed Costs		
12. Machinery Depreciation	$ 3,391	$ 26.11
13. Insurance	15	
14. Crop Building Costs	----	----
15. Interest on Investment-All Machinery	2,035	15.65
Total Fixed Costs	$ 5,441	$ 41.84
16. Custom Work Correction	----	----
TOTAL	$14,226	$109.42

PRODUCTION	ACRES	TOTAL YIELD	AV. YIELD	VALUES
Corn	130	16,277 Bu.	125.2 Bu.	$21,726

NET = $7,500

TOTAL GROSS = $21,726
GROSS PER ACRE = $167.12
NET PER ACRE = $57.70

[a]All crops were irrigated.

CHAPTER IV

CASH FLOW APPROACH TO DETERMINING CAPITAL NEEDS AND PAYBACK POSSIBILITIES

"Production by the farm firm does not take place under the conditions of riskless choice in a static environment. Production takes place in a dynamic setting. 'Without dynamic changes the firm would disappear as a planning and administrative unit in production. All that would be needed would be technical plants, each carrying on production according to the pattern of the past, repeating and re-repeating what they had done before. We conclude that what we know as the firm is the product of dynamic conditions and it is to be examined in terms of a dynamic setting.'81/

Perfect knowledge in agricultural production is rarely available in the real world. This fact points to the need to consider risk and uncertainty in the planning of production. The need for management appears in situations involving change and ignorance. Uncertainty gives rise to the need for a different framework for decision making and resource administration than does risk or certainty. The problems associated with uncertainty give rise to the need for an effective information system. The goal of any information system is to move management aspects of a business firm from the range of uncertainty to the range of risk or certainty.

The mental structure of a decision maker consists of three broad divisions: his memories of past events, his knowledge of present states, and his expectations of future events and states.82/

The knowledge of the present and the expectations of the future must be derived from information and memories of the past. The knowledge of present states is greatly affected by the degree of perfection of the information system.83/

81/ Schultz, T. W., "Theory of the Firm and Farm Management Research", Journal of Farm Economics, Vol. 21, 1939, p. 576.

82/ Boulding, Kenneth E., The Skills of an Economist, Clark, Irwin and Co., Ltd., Toronto, 1958, p.91.

83/ John R. Schlender, An Information System For Financial Management of The Farm Business, unpublished paper, Cooperative Extension Service, Kansas State University, 1970, p. 2.

Irrigation development costs and operating capital requirements for irrigation are high as has been indicated. Thus, there is a need for an information system that allows a thorough and adequate analysis of the use of capital involved in irrigation development and operation.

> "In the rather normal situation, the irrigated land must about pay its way from year to year. That is, the operator does not have another source of funds to carry this land until the investment is repaid. He is then, of necessity, concerned with annual cash costs--including annual principal and interest payments on borrowed capital. How many dollars will come in, and how many dollars must go out of the bank account each year?84/

An appropriate information system may consist of several traditional accounting techniques and some not so traditional to a good record system for the farmer. The information system the farmer chooses will be affected by income tax requirements, available data, data analysis that the farmer is academically capable of handling, the time he has available to devote to the system, the cost in dollars, the answer he expects to receive, and probably above all what his credit source 'strongly encourages' him to use and furnish.

The term cash flow has been used several times in the paper already. The cash flow statement for a farm operation is a record in the past, or a projection of future, inflow and outflow of funds from the business over a stated period of time.

> "A cash flow statement records all of the cash transactions that occur in the business. The sources of cash (income) must equal the uses for cash (expense) in any given length of time, usually a month or a year.

84/ Wilton Thomas, The Economics of Irrigation, unpublished paper used for Cooperative Extension Service, Kansas State University, Manhattan, Kansas, 1970, p. 3.

The cash flow statement combines elements of both the profit-and-loss statement and the balance sheet. Yet, differences exist between all three of these accounting statements. For example, investment in a tractor is a cash transaction that is recorded as the use of cash in the cash flow. The profit-and-loss statement reflects only the depreciation of the tractor. On the balance sheet, the tractor shows up as an asset. If borrowed money is used to purchase the tractor, then the balance sheet records the loan as a liability. When the loan is repaid, the liability is removed from the balance sheet. The cash flow does not show the net income generated by the business operation.

The cash flow statement presents all financial transactions in one report. All farm income and expenses, nonfarm business affairs, loans, debt repayments, and personal withdrawals for household spending can be summarized in the cash flow. Therefore, the cash flow can reflect an overall picture of the actual operations of the business. Not only does the cash flow present a past record of the financial transactions, but can be useful in planning future borrowing needs.

The cash flow does not have to cover the whole farm and family financial transactions, but can be set forth for individual enterprises. That is, the cash flow can summarize cash expenses and income in regards to a specific enterprise, say beef cattle.

As with all record statement, their importance depends primarily on whether or not they are used in the planning operations of the business. Therefore, the importance of the actual cash flow increases if it is used in conjunction with a projected cash flow. The projected cash flow is an estimate of next year's income and expenses generated by the business. This projected cash flow or budget can be set forth for the total business or some portion of the operation.

A monthly or enterprise breakdown of the projected cash flow will pinpoint the time when there is need to borrow and when the loan can be repaid. Thus, the manager is forced to plan the farm operation while at the same time communicate the plans to a lender in a way that helps him readily understand the credit problems. In addition, any differences between the actual and projected cash flow can be used as a guide in the decision-making process.

The managerial significance of cash flows is wrapped up in the projections made--the planned sources of and uses for cash--and, with the help of a good record system, the financial control available by checking the actual progress against the projected plans. As with any record statement, their importance

is directly related to their use."85/

An annual cash flow sheet can be completed for the farm business or any sector of it without borrowed capital and with borrowed capital. These should help in deciding whether borrowed money will contribute more to the business than its cost. If capital flow analysis is completed for each of several different amounts of borrowed capital, the most profitable level of use of borrowed funds can be estimated within a narrower range than if a hunch or only an emotional approach were used.

> "There is a tendency to want to say that the cash flow statement is a new tool in financial management. Cash flow statements are not new. They are probably about as old as the profession of bookkeeping.
>
> Earlier accounting statements were actually primarily a record of the movement of cash in the business. While they did give a good picture of the movement of dollars, they did not measure the profitability of the overall investment of the business. So, accrual accounting was developed to overcome the limitations of cash movements as indicators of business performance. Accrual accounting means that changes in inventory at the beginning and end of an accounting period are accounted for and depreciation charges are considered for investments covering more than the accounting period.
>
> Now there are good reasons for reversing the accrual process to determine the amount of cash generated by operations. Accounting reports of past cash flow may reveal a good deal about the financial problems and policies of a business. Forecasts of cash flows and cash budgets are useful managerial planning tools. The measurement of past and future flows from all sources, including operations, provides valuable financial information."86/

85/ Larry N. Langmeier, The Cash Flow Statement - Its Use, Extension Economics Kansas Farm Business Information, Kansas State University, Manhattan, Kansas, January 6, 1971, p. 1-2.

86/ John R. Schlender, The Cash Flow Statement Used as a Management Tool, unpublished paper used at May 1970 Agent Training School, Kansas State University, Manhattan, Kansas, p.1.

"Many of the dollar items that go into a cash flow statement and an income statement are the same. There is a definite philosophic difference between the two statements, however. It can best be illustrated by the way a large capital purchase, (such as an irrigation well) is handled on the two statements. On a cash flow the total amount of the purchase price appears if it was paid for in one lump sum. If it was purchased on a contract, the payments (including interest and principal) appear on the cash flow. By contrast, on an income statement only some prescribed depreciation figure appears and will continue to appear on later income statement until the machine is fully depreciated. Another major difference is that increases and decreases in inventory are a part of an income statement but they are not a part of a cash flow statement.

Why are cash flow statements more important in agriculture accounting today than they once were? Among the reasons are:

1. The use of the computer has aroused interest in them. It is one of the reports that can be easily made with a computer accounting system.

2. A larger proportion of inputs have a cash cost rather than being farm produced.

3. Farm businesses are larger and larger quantities of capital are required.

4. Higher interest rates have increased the cost of capital and consequently have increased the flow of cash.

The cash flow statement records all financial transactions in one report. All farm income and expenses, nonfarm business affairs, loans, debt payments, and personal withdrawals or household spending can be summarized in the cash flow. In this respect, most farm businesses are different than other businesses. The farm and family in most cases reach into the same bank account. Thus, the cash flow must include family 'dollars in and dollars out'."87/

Cash flow statements have been an essential tool in industry for a long time. As farm businesses grow and as larger quantities of cash are needed in their operation, cash flow statements will also become more of an essential

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87/ Ibid., p. 2.

tool in the management of farm businesses."88/

Farmers need to understand how to fill out cash flow statements for business analysis purposes and lenders have to be able to interpret them when there is need for large amounts of borrowed funds.

Prospective cash flows cannot be determined with certainty. Uncertainty inherent in capital budgeting can be analyzed with the use of probability theory. The expected cost of risk and the cost of insurance against risk can be calculated if enough experience and information is available. Oakford in Capital Budgeting pursues this subject to great length.89/ This tool of economic theory may be more helpful in the future, but with the many variables involved in irrigation development it is doubtful if information available is accurate enough or in enough volume to narrow the probability ranges of success to a fine tuned yes or no answer or a given percentage chance. Within a fairly wide band of percentage chance and without an excessively close margin of returns over cost, Oakford's technique has some merit.

> "Prospective present worth of a cash flow series is a random variable. Faced with a choice between two prospective cash flow series, the decision makers who are sure of making a long sequence of decisions would be well advised to select the alternative that has the greatest present worth. To assure that the long sequence of decisions will not be prematurely curtailed, the decision maker should not accept a proposal if it carries an unacceptable risk of ruin."90/

88/ Ibid., p. 3.

89/ Robert V. Oakford, Capital Budgeting, Ronald Press Co., New York, New York, 1970, p. 210.

90/ Ibid., p. 231.

Bonnett illustrates in diagram 2 a more realistic cash flow expectation for capital investments compared to the way many people view them. He contends that when a proposed capital investment is planned that there is a natural tendency to base a future expectation upon past experience. Future costs tend to be higher than the past due to inflation and constant pressure on non-capital inputs. Gross earnings in the long run tend to be over-estimated because later capital inputs tend to be more efficient and put pressure upon older less efficient but still functional capital items. In the short run, there is a tendency of under-estimating gross margins because of unexpected "learning benefits"91/ which at least helps offset the unexpected rising costs and new technology for a few years before an actual loss takes place.

"Cash flow is the only method known which allows us to lend more on the basis of a man's ability to produce rather than on his collateral, as we have traditionally done," says Joseph Henderson of the Continental Illinois National Bank and Trust Company.92/

> "There is no way to adequately clock the rate of our customers expansion, whether it be too slow or too fast, other than through cash flow. Cash flow is the only way to be reasonably confident ahead of time that future plans will work and the only way that we as lenders can know ahead of time how much our borrowers need, when he will need it, and how he can repay."93/

91/ John E. Bonnett, Remarks, 18th National Agricultural Credit Conference of the American Bankers Association, Hotel Fort Des Moines, Des Moines, Iowa, November 19, 1969, p. 6.

92/ Loc. cit., Henderson, p. 6.

93/ Ibid., p. 5.

Cash flow analysis is a planning tool that allows:

1. Credit lines to be found ahead of time.

2. Repayment timed to fit sales.

3. Orderly credit extensions and advancement throughout the planned period.

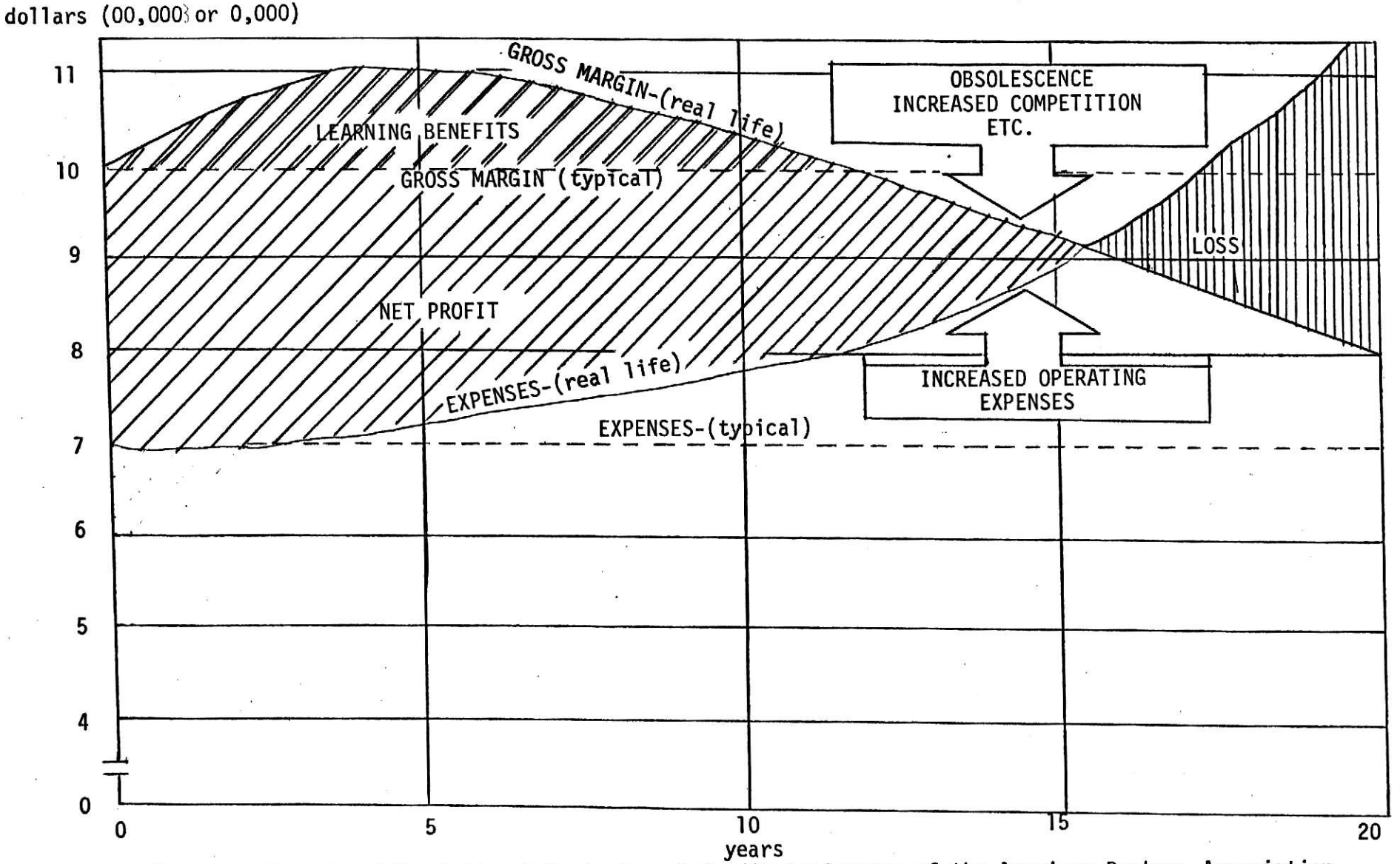
4. Paying interest only when actually needed and used.

"In recent years loan organizations are demonstrating more understanding of irrigation financing requirements. However, there is still some difficulty in financing according to needs. In the irrigation development loan, flexibility is a desirable feature. Landowners should shop for the best irrigation loan just as they might to finance a house or car. Penalties for early loan payment or refinancing should be studied or compared. Both the irrigator and the financer need to fully anticipate, not only the irrigation system capital investment requirements, but also the operation finances as related to irrigation farming. Many new irrigators find that after financing the capital investment for the irrigation system, they lack sufficient credit to operate profitably.

Irrigation-related costs, including increased fertilizer and disease control measures, should be anticipated in addition to the initial system. Such costs might also include the financing of additional animal units so as to utilize full forage irrigation potential. Most irrigation loans are made through life insurance companies, bankers, PCA, or FLB offices, and FHA."94/

94/ Robert B. Duffin, Planning For Irrigation, Science Serving Agriculture series, Oklahoma University Extension Service, Stillwater, Oklahoma, No. 1202, July 1968, p. 1.

TABLE 61.--REALISTIC CASH FLOWS RESULTING FROM A NEW INVESTMENT COMPARED TO HOW THEY ARE TYPICALLY VIEWED[a]



[a]Bonnett, Remarks, 18th National Agricultural Credit Conference of the American Bankers Association, Hotel Fort Des Moines, Des Moines, Iowa, Nov. 1969, p. 6.

CHAPTER V

FINANCIAL ANALYSIS OF CASE STUDY FARMS

A financial analysis and cash flow analysis of each of four case study farms in South-Central Kansas before and after irrigation development will be made. This will help to show the short term effects of irrigation development on family living income, debt creation and retirement and payback on investment.

Cash flow statements for case study farms have been prepared for each year by months for each farm since irrigation development began. Only the direct effects on the inflow and outflow of cash connected with the development of irrigation on the farm will be considered. The effects of other enterprises on the farms cash flow has been generally disregarded. Each case study farm had dryland enterprises and number 1 and number 3 have livestock enterprises. These enterprises' cash flow effects were not shown on the cash flow sheets. Where certain expenses or receipts were due jointly to the irrigation enterprise and another enterprise on the farm an allocation is made to the cash flow sheet on the basis of percentage of use or percentage of production. In the total aggregate of the yearly cash flow these allocations which might be subject to the bias of the allocator are of minimum consequence. All cash flow figures were taken directly from the case study Farm Management Association account books and rounded to the nearest dollar.

Many factors affect the cash flow habits of an irrigation farm. Production, machinery on hand for dryland, amount of family living that must be taken out, spending habits of the manager, loan limits,

available internal capital and how the production is marketed (cash crop or livestock); all are reflected in the cash flow picture.

A. CASE STUDY NUMBER ONE

1. Whole Farm Financial Analysis of Flood Irrigation System

The financial position of the farm can affect the cash flow. Case study farm number one had a net worth drop from 1964 to 1967 of nearly 50 percent or a total of nearly $19,000 due to heavy depreciation, relatively low returns compared to cash outflow in the learning years of irrigation, and poor cattle prices. From 1967 to 1970 the net worth has grown from $19,500 to $42,000. Total assets in 1964 were $94,500 and in 1970 they were $226,000. Liabilities increased from $56,500 to $184,000 in the same period. Most of this debt growth was due to the expansion into irrigation and the expansion of the cattle feeding operation. Table 62 shows the financial position and some other analysis characteristics of the farm. Machinery is valued at depreciated values on January 1. All other assets are at market values.

It might be noted that the gross and net income is expressed in accrual terms to allow for changes in year-end inventories. There has been a steady increase in gross income per crop acre as more irrigation is developed on the farm. The cost per crop acre has moved upward every year except 1969 when it dropped substantially from the previous high of $49.86. The 1969 drop was due primarily to less depreciation of machinery and a lower fertilizer cost per acre. The cost to obtain $100 gross has trended downward as the farm grew in size and efficiency since 1965. It should be noted that generally due to the greater purchased

inputs under irrigation over dryland that the relatively low cost of $69.91 reached in 1964 to obtain $100 gross income has not been reached since irrigation was introduced to the farm.

It should be noted that inventories of unsold crops are not added to the cash flow statements, but only the financial analysis statements.

TABLE 62.--WHOLE FARM FINANCIAL SUMMARY

OF CASE STUDY FARM NO. 1

	1964 ASSETS	1964 LIABILITIES	1964 TOTAL	1965 ASSETS	1965 LIABILITIES	1965 TOTAL
Livestock	45,934			22,436		
Crops & Supp.	3,083			2,865		
Machinery	20,706			49,324		
Cash & Account Receivable	24,821			18,290		
Land & Building	------			------		
Short Term Notes		18,222			19,048	
Intermediate Term Notes		38,178			49,575	
Long Term Notes						
Net Worth			38,144			24,192
Livestock Income			37,690			26,481
Crop Income			20,759			21,825
Total			58,449			48,306
Irr. Expense			1,383			11,178
Total Expense			36,360			31,616
Irr. Capital Purchases			22,727			3,748
Total Depreciation			4,505			6,675
Net Income For Labor, Land Equity and Management			17,584			10,002
Total Crop Acres			769			786
Total Irr. Acres						600 (partly)[a]
No. Men			2.0			2.5
Man Work Days			561			612
Man Work Days Irrigation			------			134
Gross Crop Value/ Acre			31.96			40.60
Total Crop Cost Per Acre			15.80			26.64
Total Exp. Per $100 Gross			69.91			79.26

[a]The first two years irrigation was developed the land was watered whereever the water would run and as often as possible.

TABLE 62.--WHOLE FARM FINANCIAL SUMMARY

OF CASE STUDY FARM NO. 1
(Cont.)

	1966			1967		
	ASSETS	LIABILITIES	TOTAL	ASSETS	LIABILITIES	TOTAL
Livestock	51,640			87,421		
Crops & Supp.	5,549			17,706		
Machinery	47,398			58,115		
Cash & Accounts Receivable	9,884			205		
Land & Bldg.	-----			-----		
Short Term Notes		46,972			80,195	
Intermediate Term Notes		46,637			63,786	
Long Term Notes						
Net Worth			20,862			19,466
Livestock Income			48,104			71,456
Crop Income			46,297			29,782
Total			94,401			101,237
Irr. Expense			10,524			11,308
Total Expense			61,592			69,480
Irr. Capital Purchases			4,086			3,820
Total Depreciation			12,402			9,131
Net Income For Labor, Land Equity and Management			20,407			22,625
Total Crop Acres			944			944
Total Irr. Acres			(partly)711			105
No. Men			2.5			2.4
Man Work Days			892			775
Man Work Days Irrigation			398			183
Gross Crop Value/ Acre			64.70			59.23
Total Crop Cost Per Acre			33.72			35.50
Total Exp. Per $100 Gross			78.38			77.65

TABLE 62.--WHOLE FARM FINANCIAL SUMMARY

OF CASE STUDY FARM NO. 1
(Cont.)

	1968			1969		
	ASSETS	LIABILITIES	TOTAL	ASSETS	LIABILITIES	TOTAL
Livestock	53,371			75,013		
Crops & Supp.	21,570			12,662		
Machinery	58,298			63,177		
Cash & Accounts Receivable	1,715			9,190		
Land & Building						
Short Term Notes		51,252			65,517	
Intermediate Term Notes		51,107			56,936	
Long Term Notes						
Net Worth			32,541			37,589
Livestock Income			56,593			77,867
Crop Income			52,564			55,088
Total			109,157			132,955
Irr. Expense			18,145			25,752
Total Expense			68,352			80,980
Irr. Capital Purchases			15,092			9,803
Total Depreciation			14,343			17,417
Net Income For Labor, Land Equity and Management			26,462			34,557
Total Crop Acres			996			1,079
Total Irr. Acres			236			333
No. Men			3.0			2.5
Man Work Days Irrigation			296			411
Total Man Work Days			896			1,026
Gross Crop Value/ Acre			66.27			73.69
Total Crop Cost Per Acre			49.86			34.65
Total Exp. Per $100 Gross			75.75			74.00

TABLE 62.--WHOLE FARM FINANCIAL SUMMARY

OF CASE STUDY NO. 1
(cont.)

	1970		
	ASSETS	LIABILITIES	TOTAL
Livestock	115,884		
Crops & Supp.	32,562		
Machinery	72,736		
Cash and Accounts Receivable	4,699		
Land & Building			
Short Term Notes		121,480	
Intermediate Term Notes		62,320	
Long Term Notes			
Net Worth			42,081
Livestock Income			
Crop Income			
Irr. Expense			30,105
Total Expense			
Irr. Capital Purchases			8,390

2. Cash Flow Case Study Number One

This is a partnership with a sizeable livestock project. In the cash flow only the actual irrigation costs and returns have been considered. If home raised products were fed to livestock, the inflow of cash for the feed is not shown until the livestock is sold. At that time current cash market prices are used for the feed so that any gain or loss from feeding is reflected in the livestock enterprise and not the irrigation. Internally generated funds coming from other enterprises in the farm rather than irrigation are shown under the heading, 'OTHER FARM INCOME - NOT FARM IRRIGATION OPERATION'. Cash withdrawals from the irrigation enterprise could be taken anytime the heading, 'CASH BALANCE, END OF PERIOD' is a positive amount. This was not done in these studies during the year, but 100% was withdrawn at the end of each year. 'CASH BALANCE END OF PERIOD' is not carried from one year to the next, so after the year 1966 'OTHER FARM INCOME - NOT FARM IRRIGATION OPERATION' could actually have been derived from the previous year's irrigation operations. This was done to illustrate the annual cash flow effects of irrigation.

In 1964, no production was taken from irrigated land. Actual watering began in 1965 when 689 acres out of 786 crop acres were at least partly irrigated. Full irrigation on 96 acres of silage took place. Costs and returns for the entire 689 acres were included in the cash flow study for 1965.

In 1964 $20,949 was spent on irrigation development that was self-generated money from the partners. An additional $3,161 was borrowed from the local bank. No family living was derived from the

irrigation project since there was no production the first year.

Production sales from irrigation in 1965 totaled $16,879. Total outflow of cash was $18,644 including $3,718 family living withdrawals. A Production Credit Loan of $2,280 was taken by the farm to increase the cash inflow during the year. None of the 1964 bank loans were payed off in 1965. There was $515 available from cash irrigation sales, borrowed PCA cash minus cash outflow to apply to repayment of the $20,949 self-generated development money needed in 1964.

In 1966 there was an inflow of $37,315 from irrigation sales plus $3,632 income from other enterprises or from the previous years irrigation sales. The inflow not counting loans surpassed outflow. The outflow for 1966 was $29,618 including $9,001 family living costs. There was $3,680 additional PCA loans and loans from one of the partners added during 1966 to the total debt by the partnership for irrigation operations. The 1966 net effect of the inflow plus loans minus outflow left $15,009 cash on balance January 1, 1967. This money was available for future irrigation operation and development and for other farm enterprises.

In 1967 irrigation sales totaled $21,901. Another $9,694 was added to the inflow of cash to the farm irrigation operation. This came from other enterprises or from irrigation sales in 1966. The outflow of cash for irrigation was $15,128. Another $12,187 family living withdrawals was added to this outflow of cash to total $27,315. Net loan position for the year was a $4,280 reduction of debt from the beginning of the year. There was no cash balance for irrigation

at the end of the year.

Irrigation sales in 1968 totaled $46,392. Other inflow of cash of $9,555 brought the total inflow of cash for 1968 to $55,947. Total outflow for operations, capital purchases and family living was $45,452. Debt decreased by $2,481 during 1968. A $7,654 cash balance was on hand for irrigation at the end of 1968.

In 1969 irrigation sales totaled $27,445. Non-irrigation cash generation of $5,370 was provided to help pay outflow demands. Total outflow was $45,915 for operation, capital purchases, and family living. Debt was increased by $13,100 from January 1, 1969 to December 31,1969 for the irrigation enterprise. Again, there was no cash balance available at the end of the year.

Irrigation sales of $49,440 occurred in 1970. Another $8,394 inflow of cash was added from other enterprises to bring the total non-loan inflow to $57,834. Outflow of cash for 1970 was $57,174. This included debt reduction of $650 during the year of 1970.

Tables 63 to 69 give a monthly cash flow for 1964 to 1970 for case study farm number 1. It might be noted that this farm has never been out of debt on its irrigation enterprise. It had $14,450 debt January 1971 from irrigation development. By adding the total non-irrigation self-generated inflow of cash (Other Farm Income - Not Farm Irrigation Operation) and subtracting Cash Balance at the end of the year it is apparent that $34,416 has been taken from other enterprises on the farm over and above the irrigation sales. This might leave the reader questioning the value of irrigation in cash generation. It must be recalled that this farm has been in an almost constant irri-

gation development program since 1964. All development costs were paid. In addition to this the farm has extracted from irrigation $66,464 for family living.

Cash inflow from irrigation since 1964 for the farm has surpassed cash outflow for all irrigation development costs and irrigation operation costs by $17,598. Most of the irrigation operation costs are of course used up but the development costs will continue to generate income for many more years. A sizeable inventory of unsold irrigated crops was on hand January 1, 1971 also. With this type of analysis irrigation appears a more attractive alternative method of farming for this farm.

There was wide variation between inflow from irrigation sales from year to year on this farm. The variation was from $16,879 the first year to $49,440 in 1970. This variation is due to increasing irrigation development over the years, inconsistent marketing date patterns, variance in yield and price over the years. This variance had a definite effect on when debt was incurred and retired, and when funds were available for expansion, paying bills and for family living expenses.

TABLE 63.

CASH FLOW FOR 1964
NAME Case No. 1 Date Prepared Post

		Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE					ESTIMATED TOTAL CASH INFLOW									
1	Livestock:														
2															
3															
4															
5	Crops:														
6															
7															
8															
9	Custom Work														
10	Gas Tax, Co-op & etc. Refunds														
11	Gov't Payments								5173	1326	1544	316	12499	91	20,949
12	Other Farm income														
13	Other Farm income														
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)								5173	1326	1544	316	12499	91	20,949
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income														
18	TOTAL CASH INFLOW (Add 14 thru 17)								5173	1326	1544	316	12499	91	20,949
	EXPENSE SOURCE					ESTIMATED TOTAL CASH OUTFLOW									
19	Feed Purchased														
20	Hired Labor														
21	Farm Fuel									18		70	89		177
22	Auto Expense														
23	Machine Repairs									26	24	8			58
24	Machine Hire														
25	Livestock Expense														
26	Fertilizer										630	216	57		903
27	Crop Expense								13	20	31	7	52	91	201
28	Utilities											15			15
29	Farm Dues & Fees												16		16
30	Real Estate and Personal Property Taxes														
31	Cash Rent														
32	Interest														
33	Insurance														
34	Repairs on Permanent Improvements														
35	Other Farm Expense														
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)								13	64	685	316	214	91	1,383
37	Purchased Livestock														
38	Purchased Machinery and Capital Improvements								5160	2562	859	1861	12285	--	22,727
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)								5173	2626	1544	2177	12499	91	24,110
40	Family Living Expense														
41	Other non-farm expense														
42	TOTAL CASH OUTFLOW (Add 39 thru 41)								5173	2626	1544	2177	12499	91	24,110
						SUMMARY OF CREDIT NEEDS									
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)								----	(-1300)	----	(-1861)	----	--	(-3,161)
44	Cash Available, beg.of period (prev.end of per.)	xxxx							----	----	----	----	----	--	-----
45	Total Cash Available (Add 43 + 44)	xxxx							----	(-1300)	----	(-1861)	----	--	(-3,161)
46	Borrowing Necessary to Maintain $ balance								----BK	1300	----BK	1861	----	--	3,161
47	Payment on Principal										----	----	----	--	-----
48	Total Current Debt (prev. period debt + 46 - 47)										1300	3161	3161	3161	
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx							----	----	----	----	----	----	-----

TABLE 64.

	CASH FLOW 1965 NAME Case Study No. 1 Date Prepared Post	Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE					ESTIMATED TOTAL CASH INFLOW									
1	Livestock:														1
2															2
3															3
4															4
5	Crops: Wheat								1563	4994					6,557 5
6	Grain Sorghum												1245	1133	2,378 6
7															7
8															8
9	Custom Work								356	302	400	770	154	372	2,354 9
10	Gas Tax, Co-op & etc. Refunds		398	10	71		552					117			1,148 10
11	Gov't Payments				484					433	3525				4,442 11
12	Other Farm income- Not Farm Irrigation Operation			1184		160	1190	1885	291						4,710 12
13	Other Farm income														13
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)		398	1194	555	160	1742	1885	2210	5729	3925	887	1399	1505	21,589 14
15	Non-farm business, wages, etc.														15
16	Non-farm dividends & interest														16
17	Other non-farm income														17
18	TOTAL CASH INFLOW (Add 14 thru 17)		398	1194	555	160	1742	1885	2210	5729	3925	887	1399	1505	21,589 18
	EXPENSE SOURCE					ESTIMATED TOTAL CASH OUTFLOW									19
19	Feed Purchased							380	361	190	86	---	163	490	1,670 20
20	Hired Labor					112	145	140	200	124	140	128	67	35	1,130 21
21	Farm Fuel			39											22
22	Auto Expense					94	452	417	290	177	133	54	129	198	2,245 23
23	Machine Repairs			301					200		22			369	634 24
24	Machine Hire				43										25
25	Livestock Expense						647		415	103	568	527		103	3,481 26
26	Fertilizer			1118		200	120	44	335	33	248	465	16	10	1,474 27
27	Crop Expense				2				15		15		5		45 28
28	Utilities			10				7							54 29
29	Farm Dues & Fees		47												30
30	Real Estate and Personal Property Taxes														31
31	Cash Rent														287 32
32	Interest					41									41 33
33	Insurance													48	118 34
34	Repairs on Permanent Improvements														35
35	*Other Farm Expense*					447	1364	988	1886	627	1212	1461	380	1253	11,178 36
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		47	1468	45										37
37	Purchased Livestock					176	378	897	324	1807	----	----	---	42	3,748 38
38	Purchased Machinery and Capital Improvements			77	47	623	1742	1885	2210	2434	1212	1461	380	1295	14,926 39
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		47	1545	92					533	1605	223	918	439	3,718 40
40	Family Living Expense														41
41	Other non-farm expense					623	1742	1885	2210	2967	2817	1684	1298	1734	18,644 42
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		47	1545	92										
						SUMMARY OF CREDIT NEEDS									
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)		351	(-351)	463	(-463)	---	----	----	2762	1108	(-797)	101	(-229)	2,945 43
44	Cash Available, beg.of period (prev.end of per.)	xxxx	---	351	---	463	---	----	----	----	2762	3870	3073	5454	15,973 44
45	Total Cash Available (Add 43 + 44)	xxxx	351	---	463	---	---	----	----	2762	3870	3073	3174	5225	18,918 45
46	Borrowing ~~Necessary to Maintain ◊ ----- balance~~		---	---	---	---	---	----	----	----	----	--PCA	2280	----	2,280 46
47	Payment on Principal		---	---	---	---	---	----	----	---	----	----	----	----	------- 47
48	Total Current Debt (prev. period debt + 46 - 47)		3161	3161	3161	3161	3161	3161	3161	3161	3161	3161	5441	5441	48
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx	351	---	463	----	----	----	----	2762	3870	3073	5454	5225	21,198 49

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TABLE 65.

CASH FLOW 19 66
NAME Case Study No. 1 Date Prepared Post

		Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE					ESTIMATED TOTAL CASH INFLOW									
1	Livestock: Cattle							1000	5100	672	700				7,472
2															
3															
4															
5	Crops: Wheat				153			1921		3892				5049	11,015
6	Grain Sorghum		118	753									3709	1315	5,895
7	Corn											4150			4,150
8															
9	Custom Work				84			355		188	213	650	869	364	2,723
10	Gas Tax, Co-op & etc. Refunds			60			78								138
11	Gov't Payments					184				2532	3406				6,121
12	Other Farm income - Not Farm Irrigation Operation		700					515	2417						3,632
13	Other Farm income														
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)		818	813	237	184	78	3791	7517	7284	4319	4800	4378	6728	40,947
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income														
18	TOTAL CASH INFLOW (Add 14 thru 17)		818	813	237	184	78	3791	7517	7284	4319	4800	4378	6728	40,947
	EXPENSE SOURCE					ESTIMATED TOTAL CASH OUTFLOW									
19	Feed Purchased														
20	Hired Labor							213	263	290	219	---	100	150	1,235
21	Farm Fuel			65	160	230	82	---	270	156	---	303	290	---	1,556
22	Auto Expense														
23	Machine Repairs		102	30	370	155	150	759	387	350	219	344	290	77	3,083
24	Machine Hire							1221				1044	774	252	3,291
25	Livestock Expense														
26	Fertilizer				808	36	2131		833						3,808
27	Crop Expense			158		1	254	308	173	61	15	----	---	65	1,035
28	Utilities														
29	Farm Dues & Fees							55							55
30	Real Estate and Personal Property Taxes													380	380
31	Cash Rent													1680	1,680
32	Interest											258			258
33	Insurance														
34	Repairs on Permanent Improvements														
35	Other Farm Expense														
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		102	253	1338	422	2617	2556	1926	857	453				10,524
37	Purchased Livestock														
38	Purchased Machinery and Capital Improvements								591		3495				4,086
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		102	253	1338	422	2617	2556	2517	857	3948	1949	1454	2604	20,617
40	Family Living Expense		716	560	199	226	589	3343	----	---	1503	581	457	827	9,001
41	Other non-farm expense														
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		818	813	1537	648	3206	5899	2517	857	5451	2530	1911	3431	29,618
						SUMMARY OF CREDIT NEEDS									
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)		---	---	(-1300)	(-464)	(-3128)	(-2108)	5000	6427	(-1132)	2270	2467	3297	11,329
44	Cash Available, beg.of period (prev.end of per.)	xxxx	---	---	----	700	2236	2108	----	----	6427	5295	7565	10032	34,363
45	Total Cash Available (Add 43 + 44)	xxxx	---	---	(-1300)	236	(-892)	----	5000	6427	5295	7565		13329	35,660
46	Borrowing Necessary to Maintain $ balance		---	---PCA	2000	2000BK	3000BK	----	----	----	----	----	Indv.	1680	8,680
47	Payment on Principal		---	---	----	----	----	---BK	5000	----	----	----	----	-----	5,000
48	Total Current Debt (prev. period debt + 46 - 47)		5441	5441	7441	9441	12441	12441	7441	7441	7441	7441	7441	9121	
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx	----	----	700	2236	2108	-----	----	6427	5295	7565	10032	15003	49,312

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TABLE 66.

	CASH FLOW . 19 67 NAME Case Study No. 1 Date Prepared Post	Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE					ESTIMATED TOTAL CASH INFLOW									
1	Livestock: Home Raised Feed, Fed & Sold through Cattle			1662		800	8643				3738				14,843
2															
3															
4															
5	Crops: Wheat		223		1051										1,280
6	Grain Sorghum													2896	2,896
7	Corn														
8															
9	Custom Work									124	266				390
10	Gas Tax, Co-op & etc. Refunds				52										52
11	Gov't Payments				975						1465				2,440
12	Other Farm income		354	4182								155	2885	2118	9,694
13	Other Farm income														
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)		577	5844	2084	800	8643			124	5469	155	2885	5014	31,595
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income														
18	TOTAL CASH INFLOW (Add 14 thru 17)		577	5844	2084	800	8643			124	5469	155	2885	5014	31,595
	EXPENSE SOURCE					ESTIMATED TOTAL CASH OUTFLOW									
19	Feed Purchased														
20	Hired Labor									237	708	125			1,070
21	Farm Fuel		60		30	220	100	110	65	95	160	40	28		9,080
22	Auto Expense														
23	Machine Repairs			20	13	51	147	17	130	214	248	125	57	348	1,370
24	Machine Hire											1611	198	196	2,005
25	Livestock Expense														
26	Fertilizer					1766	137		348	68					2,319
27	Crop Expense				271		22	171	7	112	25		12	15	635
28	Utilities				15										15
29	Farm Dues & Fees							50	8	10					68
30	Real Estate and Personal Property Taxes													320	320
31	Cash Rent												1890		1,890
32	Interest			308		280									588
33	Insurance					120									120
34	Repairs on Permanent Improvements														
35	Other Farm Expense														
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		60	328	339	2437	406	348	558	736	1141	1901	2185	869	11,308
37	Purchased Livestock						300	120	1200	2200					3,820
38	Purchased Machinery and Capital Improvements					2437	706	468	1758	2936	1141	1901	2185	869	15,128
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		60	328	339	1193		231	2068	1456			700	4145	12,187
40	Family Living Expense		517	1236	641										
41	Other non-farm expense					3630	706	699	3826	4392	1141	1901	2885	5014	27,315
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		577	1564	980										
						SUMMARY OF CREDIT NEEDS									
43	NET CASH FLOW (+ or -) (Sub, 18 - 42)		---	4280	1104	(-2830)	7937	(-699)	(-3826)	(-4286)	4328	(-1746)	----	----	4,280
44	Cash Available, beg.of period (prev.end of per.)	xxxx	---	----	----	1104	274	8211	9512	5686	1418	3746	----	----	29,951
45	Total Cash Available (Add 43 + 44)	xxxx	---	4280	1104	(-1726)	8211	7512	5686	1418	5746	2000	----	----	34,231
46	Borrowing Necessary to Maintain $ balance		---	----	----BK	2000	---	BK 2000	----	----	----	BK 1800	----	----	5,800
47	Payment on Principal		---PCA	4280	----	----	----	----	----	----	2000	3800	----	----	10,080
48	Total Current Debt (prev. period debt + 46 - 47)		9121	4841	4841	6841	6841	8841	8841	8841	6841	4841	4841	4841	
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx	----	----	1104	274	8211	9512	5686	1418	3746	----	----	----	29,951

Extension Service, K. S. U.

TABLE 67.

	CASH FLOW 19 68 NAME Case Study No. 1 Date Prepared Post	Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE						ESTIMATED TOTAL CASH INFLOW								
1	Livestock: Home Raised Feed Sold Through Cattle								6525						6,525
2															
3															
4															
5	Crops: Corn		13264				2479					7036	7304		30,083
6	Grain Sorghum						893								893
7	Silage										574	1643			2,217
8	Soybeans													944	944
9	Custom Work						60	150			630	530	122	250	1,742
10	Gas Tax, Co-op & etc. Refunds			20			50		30						100
11	Gov't Payments										3888				3,888
12	Other Farm income-Not Farm Irrigation Operation									9555					9,555
13	Other Farm income														
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)		13264	20			3482	150	6555	9555	5092	9209	7426	1194	55,947
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income														
18	TOTAL CASH INFLOW (Add 14 thru 17)		13264	20			3482	150	6555	9555	5092	9209	7426	1194	55,947
	EXPENSE SOURCE						ESTIMATED TOTAL CASH OUTFLOW								
19	Feed Purchased														
20	Hired Labor		115	181	537	456	411	499	22	398	31	----	66	653	3,369
21	Farm Fuel		15	60	80	210	130	280	160	190	290	130	----	60	1,605
22	Auto Expense														
23	Machine Repairs				15	13	18	71	11	262	18	----	----	----	408
24	Machine Hire				73	110	6	---	---	---	2235	723	648	----	3,795
25	Livestock Expense														
26	Fertilizer				3079	---	---	711	295	---	953	---	---	----	5,038
27	Crop Expense			12		2156	477	558	284	17	---	---	---	----	4,460
28	Utilities														
29	Farm Dues & Fees												4		4
30	Real Estate and Personal Property Taxes													190	190
31	Cash Rent												1890		1,890
32	Interest					140									140
33	Insurance					120									120
34	Repairs on Permanent Improvements														
35	Other Farm Expense														
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		130	241	3784	1049	1042	2119	772	867	3527	853	2608	1153	18,145
37	Purchased Livestock														
38	Purchased Machinery and Capital Improvements					2929	737	250	1168	6747			3261		15,092
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		130	241	3784	3978	1779	2369	1940	7614	3527	853	5869	1153	33,237
40	Family Living Expense		1800	600	400	2500		900	1100	1050	200	1700	700	1265	12,215
41	Other non-farm expense														
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		1930	841	4184	6478	1779	3269	3040	8664	3727	2553	6559	2418	45,452
							SUMMARY OF CREDIT NEEDS								
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)		11334	(-821)	(-4184)	(-6478)	1703	(-3119)	3515	1891	1365	6656	857	(-1224)	10,495
44	Cash Available, beg.of period (prev.end of per.)	xxxx	----	11334	16013	11829	5351	7054	3935	1950	---	1365	8021	8878	75,730
45	Total Cash Available (Add 43 + 44)	xxxx	11334	10513	11829	5351	7054	3935	7450	2841	1365	8021	8878	7654	86,225
46	Borrowing Necessary to Maintain $ balance		----	5500	----										5,500
47	Payment on Principal		----	----	----	----	----	----	5500	2841	----	----	----	----	8,341
48	Total Current Debt (prev. period debt + 46 - 47)		4841	10341	10341	10341	10341	10341	4841	2000	2000	2000	2000	2000	
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx	11334	16013	11829	5351	7054	3935	1950	----	1365	8021	8878	7654	83,384

TABLE 68.

	CASH FLOW 19 69 NAME Case Study No.1 Date Prepared Post	Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE						ESTIMATED TOTAL CASH INFLOW								
1	Livestock:							9127	6100						15,227
2															
3															
4															
5	Crops: Corn									4595				1075	5,670
6	Silage or Damages													918	918
7															
8															
9	Custom Work								210			157		126	493
10	Gas Tax, Co-op & etc. Refunds		40				30								70
11	Gov't Payments										5067				5,067
12	Other Farm income														
13	Other Farm income												912	4458	5,370
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)		40				30	9127	6310	4595	5067	157	912	6517	32,815
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income														
18	TOTAL CASH INFLOW (Add 14 thru 17)		40				30	9127	6310	4595	5067	157	912	6517	32,815
	EXPENSE SOURCE						ESTIMATED TOTAL CASH OUTFLOW								
19	Feed Purchased														
20	Hired Labor		95			18	3	304	210	143	7	62		317	1,159
21	Farm Fuel		44				188	148	459		387	96	117	75	1,514
22	Auto Expense														
23	Machine Repairs		24	267	23	174	28	66	195	395	62	94	234	238	1,800
24	Machine Hire						137	85				3843	400	75	4,540
25	Livestock Expense														
26	Fertilizer						1740	1999					687	1749	6,175
27	Crop Expense		7		492	251	2146	921	49	100	63		107		4,136
28	Utilities									20					20
29	Farm Dues & Fees		60												60
30	Real Estate and Personal Property Taxes							260						220	480
31	Cash Rent											3365		1890	5,255
32	Interest								112						122
33	Insurance						200								200
34	Repairs on Permanent Improvements														
35	Other Farm Expense														
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		230	267	516	443	4442	3783	1025	658	519	7460	1545	4564	25,752
37	Purchased Livestock														
38	Purchased Machinery and Capital Improvements		261			80	1558	1230			6671				9,803
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		491	267	516	523	6000	5013	1025	658	7190	7460	1545	4564	35,249
40	Family Living Expense		200	700		900	950			2500	2100	800	500	2013	10,663
41	Other non-farm expense														
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		691	967	516	1423	6950	5013	1025	3158	9290	8260	2045	6577	45,915
							SUMMARY OF CREDIT NEEDS								
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)		(-651)	(-967)	(-516)	(-1423)	(-6920)	4114	5285	1437	(-4223)	(-8103)	(-1133)	----	(-13,100)
44	Cash Available, beg.of period (prev.end of per.)	xxxx		4349	3382	5366	7943	3523	3137	5422	6859	9236	1133	----	50,750
45	Total Cash Available (Add 43 + 44)	xxxx	(-651)	3382	2866	3943	1023	7637	8422	6859	2636	1133	----	----	37,250
46	Borrowing Necessary to Maintain $ balance		BK5000		BK2500	BK4000	BK2500	----	----	----	Dealer 6600	----	----	----	20,600
47	Payment on Principal		----	----	----	----	----	BK 4500	BK 3000	----	----	----	----	----	7,500
48	Total Current Debt (prev. period debt + 46 - 47)		7000	7000	9500	13500	16000	11500	8500	8500	15100	15100	15100	15100	
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx	4349	3382	5366	7943	3523	3137	5422	6859	9236	1133	----	----	50,350

TABLE 69.

CASH FLOW 19 70
NAME Case Study No. 1 Date Prepared Post

		Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE					ESTIMATED TOTAL CASH INFLOW									
1	Livestock:				12500		6000		10263	2400					31,163
2															
3															
4															
5	Crops: Corn										7399			6895	14,294
6	Silage													3510	3,510
7															
8															
9	Custom Work											10	381		391
10	Gas Tax, Co-op & etc. Refunds						82								82
11	Gov't Payments					4537						306		3551	8,394
12	Other Farm income														
13	Other Farm income														
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)				12500	4537	6082		10263	2400	7399	316	381	13956	57,834
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income														
18	TOTAL CASH INFLOW (Add 14 thru 17)				12500	4537	6082		10263	2400	7399	316	381	13956	57,834
	EXPENSE SOURCE					ESTIMATED TOTAL CASH OUTFLOW									
19	Feed Purchased														
20	Hired Labor		19	10	36		57	5	58	330	122				647
21	Farm Fuel				278	230		120	203	790	538		109	36	2,304
22	Auto Expense														
23	Machine Repairs				702	320	406	306		81	348	45		70	2,278
24	Machine Hire				252					707	1429	1922	1110		5,420
25	Livestock Expense				3126										3,126
26	Fertilizer				2670	1279		1823	359						6,131
27	Crop Expense							1949							1,949
28	Utilities					15			20		72				107
29	Farm Dues & Fees		23	20	15				20						78
30	Real Estate and Personal Property Taxes								290					300	590
31	Cash Rent							719				3366		1890	5,975
32	Interest				492						535				1,227
33	Insurance						250							32	282
34	Repairs on Permanent Improvements														
35	Other Farm Expense														
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		42	30	7571	2044	713	4922	950	1908	3044	5333	1219	2329	30,105
37	Purchased Livestock														
38	Purchased Machinery and Capital Improvements								4120	191	989			3090	8,390
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		42	30	7571	2044	713	4922	5070	2099	4033	5333	1219	5419	38,494
40	Family Living Expense		1400	750	200			1200	2130	300	1700	300	600	10100	18,680
41	Other non-farm expense														
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		1442	780	7771	2044	713	6122	7200	2399	5733	5633	1819	15518	57,174
						SUMMARY OF CREDIT NEEDS									
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)		(-1442)	(-780)	4729	2493	5369	(-6122)	3063	1	1666	(-5317)	(-1438)	(-1562)	664
44	Cash Available, beg.of period (prev.end of per.)	xxxx		558	2778	2507	----	5369	11247	7300	5301	5317	----	1562	41,939
45	Total Cash Available (Add 43 + 44)	xxxx	(-1442)	(-222)	7507	5000	5369	(-753)	14300	7301	6967	----	(-1438)	----	42,589
46	Borrowing Necessary to Maintain $ balance		2000	3000	----	----	----	12000	----	----	----	----	3000	----	20,000
47	Payment on Principal				BK5000	5000	----	----	7000	2000	1650	----	----	----	20,650
48	Total Current Debt (prev. period debt + 46 - 47)		17100	20100	15100	10,100	10,100	22,100	15,100	13,100	11,450	11,450	14,450	14,450	
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx	558	2778	2507	----	5369	11247	7300	5301	5317	----	1562	----	41,939

B. CASE STUDY NUMBER TWO

1. Whole Farm Analysis of A Flood Irrigation System

This farm has experienced a fairly rapid net worth growth. It has gone from $184,041 in 1968 to $212,151 in 1971, or an average of $9370 per year. During the same period family living, social security taxes, state income taxes, federal income taxes, and life insurance averaged $11,705 per year. It is evident that irrigation has played a significant part in adding to the net worth growth and family living income.

This farm had a relatively poor wheat crop on dryland which probably was a significant factor in the low net income of $198 in 1967 - the year before irrigation was added. The gross return per crop acre in 1967 was $44.92 per acre compared to the $72.65 per acre in 1968. The operating costs per crop acre were $27.54 in 1967 compared with $33.02 in 1968. Costs and returns per crop acre have trended upward every year since irrigation was introduced to the farm. The overall farm expenses to get $100 gross return for the farm was $99.20 in 1967 and has been as low as $51.23 in the relatively good gross-income year of 1969. Irrigation has been given credit by the farmer for stabilizing the income for this farm and furnishing greater returns to labor, land and management than was the case under dryland conditions.

Table 70 shows the financial analysis of the farm operation that includes both irrigation study number two and number four for the period 1968 through 1971.

TABLE 70.--WHOLE FARM FINANCIAL SUMMARY

OF CASE STUDY FARM NO. 2 & 4

	1968			1969		
	ASSETS	LIABILITIES	TOTAL	ASSETS	LIABILITIES	TOTAL
Livestock	------			------		
Crops & Supp.	4,866			11,714		
Machinery	33,370			38,274		
Cash & Accounts Receivable	37,006			27,452		
Land & Building	109,000			109,000		
Short Term Notes		------			------	
Intermediate Term Notes		------			------	
Long Term Note		------			------	
Net Worth			184,041			186,440
Livestock Income			-188			------
Crop Income			45,618			61,521
Total			45,430			61,521
Irr. Expense			5,908			6,071
Total Expense			22,954			22,408
Irr. Capital Purchases			11,115			1,172
Total Depreciation			6,012			9,113
Net Income for Labor, Land Equity and Management			16,654			30,001
Total Crop Acres			909			909
Total Irr. Acres			100			100
No. Men			1.9			1.3
Man Work Days			416			428
Man Work Days Irrigation			110			110
Gross Crop Value/ Acre			72.65			79.77
Total Crop Cost Per Acre			33.02			36.07
Total Exp. Per $100 Gross			63.50			51.23

TABLE 70.--WHOLE FARM FINANCIAL SUMMARY

OF CASE STUDY FARM NO. 2 & 4

	1970			1971		
	ASSETS	LIABILITIES	TOTAL	ASSETS	LIABILITIES	TOTAL
Livestock	------			------		
Crops & Supp.	28,819			25,472		
Machinery	36,292			58,627		
Cash & Accounts Receivable	32,688			24,052		
Land & Building	109,000			109,000		
Short Term Notes		------			5,000	
Intermediate Term Notes		------				
Long Term Notes		------				
Net Worth			206,798			212,151
Livestock Income			------			
Crop Income			67,360			
Total			67,360			
Irr. Exp.			18,664			
Total Exp.			33,488			
Irr. Capital Purchases			28,711			
Total Depreciation			17,310			
Net Income For Labor, Land Equity and Management			16,562			
Total Crop Acres			907			
Total Irr. Acres			250			
No. Men			1.5			
Man Work Days			527			
Man Work Days Irrigation			273			
Gross Crop Value/Acre			91.56			
Total Crop Cost Per Acre			56.14			
Total Exp. Per $100 Gross			75.40			

2. Cash Flow Case Study Number Two

This farm was developed for irrigation in 1968 when two 47 foot wells were drilled and tied together to supply the head estimated to be needed. As it turned out one well would have supplied enough water.

One hundred acres of corn was grown under full irrigation the first year and every year since. It is sold as a cash crop, usually in the year harvested.

No capital for development was borrowed. Two short-term bank loans for $5,000 were used in 1968, but were repaid after the corn was sold in the fall. Another $8,000 loan in 1969 was used until after the 1969 crop was sold. The borrowing habits of this farm reflect a good self-generating of capital, relatively high internal-liquidity, and a typical borrowing pattern for a cash-crop farm. A relatively low development cost and little need for additional capital machinery purchases have held his intermediate and long-term capital needs due to irrigation to a little over $13,000 during the three year operation period. A contrast to this example of little need for intermediate term capital, will be shown in case study four which is the same farm unit. The operator needed to borrow more capital.

Cash irrigation inflow over cash irrigation outflow including all development costs was $4,669 for the years 1968-1970. This is exceptionally good. This means if nothing had been withdrawn for income taxes, social security taxes, or family living the irrigation development in 1968 plus all annual variable costs would have been paid and $4,669 left over. In reality and average of $6,175 per

year was withdrawn from the irrigation enterprise each of the three years of 1968, 1969, and 1970 for family living, income taxes, social security taxes and life insurance. This total $18,530 withdrawal prevented the payback of the $13,087 capital investments made for irrigation and an additional $5443 funds had to be absorbed by other enterprises on the case study farm number two. Since this operator was using very little borrowed capital he had the freedom to decide from which enterprise he would withdraw funds for family living and at what rate he would pay himself for his capital investment. Where borrowed capital is utilized these decisions are often controlled by the loaning institution.

Tables 71 to 73 give a monthly cash flow for this farm unit.

Table 71.

CASH FLOW 1968
NAME Case No. 2 Date Prepared Post

		Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE					ESTIMATED TOTAL CASH INFLOW									
1	Livestock:														
2															
3												14,016			14,016
4															
5	Crops: Corn														
6															
7															
8															
9	Custom Work														
10	Gas Tax, Co-op & etc. Refunds														
11	Gov't Payments					2260		849	3261	75	85			79	11,716
12	Other Farm income		2607	2400											
13	Other Farm income					2260		849	3261	75	85	14,016		79	25,732
14	*TOTAL FARM CASH INFLOW* (Add 1 thru 13)		2670	2400											
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income														
18	TOTAL CASH INFLOW (Add 14 thru 17)		2670	2400		2260		849	3261	75	85	14,016		79	25,732
	EXPENSE SOURCE					ESTIMATED TOTAL CASH OUTFLOW									
19	Feed Purchased								250	150		145	25	350	920
20	Hired Labor					152	154		27	25	65	50	70		587
21	Farm Fuel			44		30	20		40					40	130
22	Auto Expense					264	136	230			20		113	30	894
23	Machine Repairs			101				2709							2709
24	Machine Hire														
25	Livestock Expense					1314	600		425						2879
26	Fertilizer								251						251
27	Crop Expense														15
28	Utilities			15											
29	Farm Dues & Fees														
30	Real Estate and Personal Property Taxes														
31	Cash Rent												272		272
32	Interest														
33	Insurance														
34	Repairs on Permanent Improvements														
35	Other Farm Expense					2260	910	2939	993	175	85	195	480	420	8617
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		----	160											
37	Purchased Livestock								6268						11115
38	Purchased Machinery and Capital Improvements		2670	2240		2260	910	2939	7261	175	85	195	480	420	19732
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		2670	2400		st.)	1000	1000	1000			1000	1000	1000	6000
40	Family Living Expense		(Total Known -- Months												
41	Other non-farm expense					2260	1910	3939	8261	175	85	1195	1480	1420	25,732
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		2670	2400											
						SUMMARY OF CREDIT NEEDS									
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)		----	----		-----	(-1910)	(-3090)	(-5000)	---	----	12821	(-1480)	(-1341)	-----
44	Cash Available, beg.of period (prev.end of per.)	xxxx	----	----		-----	-----	3090	-----	----	----	----	12821	1341	17,252
45	Total Cash Available (Add 43 + 44)	xxxx	----	----		-----	(-1910)	-0-	(-5000)	----	----	12821	11341	------	17,252
46	Borrowing Necessary to Maintain $ balance		----	----			5000		5000						10,000
47	Payment on Principal												10000		10,000
48	Total Current Debt (prev. period debt + 46 - 47)						5000	5000	10000	10000	10000	10000			
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx	----	----		-----	3090	----	-----	-----	-----	12821	1341	-----	17,252

TABLE 72.

	CASH FLOW 1969 NAME Case No. 2 Date Prepared Post	Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE					ESTIMATED TOTAL CASH INFLOW									
1	Livestock:														1
2															2
3															3
4															4
5	Crops: Corn											12000		3000	15,000
6															6
7															7
8															8
9	Custom Work														9
10	Gas Tax, Co-op & etc. Refunds														1
11	Gov't Payments										933				933
12	Other Farm income		1900	801	68	0 2129	1298			510	3308				10,626
13	Other Farm income														1
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)		1900	801	68	0 2129	1298			510	4241	12000		3000	26,559
15	Non-farm business, wages, etc.														1
16	Non-farm dividends & interest														1
17	Other non-farm income														1
18	TOTAL CASH INFLOW (Add 14 thru 17)		1900	801	68	0 2129	1298			510	4241	12000		3000	26,559
	EXPENSE SOURCE					ESTIMATED TOTAL CASH OUTFLOW									
19	Feed Purchased								126	60		144	300		630
20	Hired Labor					190	43			50	34	86		55	481
21	Farm Fuel			23											
22	Auto Expense					0 77	31				64	164		35	519
23	Machine Repairs			48	1(		52	330	220	30					632
24	Machine Hire														
25	Livestock Expense					982		1043							2,025
26	Fertilizer							801	670						1,471
27	Crop Expense								20						20
28	Utilities														
29	Farm Dues & Fees														
30	Real Estate and Personal Property Taxes														
31	Cash Rent										143				143
32	Interest														150
33	Insurance			150											
34	Repairs on Permanent Improvements														
35	Other Farm Expense														
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		----	221	10	) 1249	126	2174	1036	140	241	394	300	90	6,071
37	Purchased Livestock						592								
38	Purchased Machinery and Capital Improvements		580												1,172
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		580	221	10	) 1249	718	2174	1036	140	241	394	300	90	7,243
40	Family Living Expense		1320	580	58	) 880	580	580	580	---	---	580	580	580	6,840
41	Other non-farm expense														
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		1900	801	68	) 2129	1298	2754	1616	140	241	974	880	670	14,083
						SUMMARY OF CREDIT NEEDS									
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)		----	---	--	- ----	----	(-2754)	(-1616)	370	4000	11026	(-880)	2330	22,976
44	Cash Available, beg.of period (prev.end of per.)	xxxx	----	----		- ----	----	----	5246	3630	----	-----	11026	10146	30,048
45	Total Cash Available (Add 43 + 44)	xxxx	----					(-2754)	3630	4000	4000	11026	10146	12476	48,032
46	Borrowing Necessary to Maintain $ balance		----					8000							8,000
47	Payment on Principal		----							4000	4000				8,000
48	Total Current Debt (prev. period debt + 46 - 47)		----					8000	8000	4000	----	-----			
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx	----	---	-	-		5246	3630	----	----	11026	10146	12476	41,524

TABLE 73.

CASH FLOW 1970
NAME Case No. 2 Date Prepared Post

		Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE					ESTIMATED TOTAL CASH INFLOW									
1	Livestock:														
2															
3															
4															
5	Crops: Corn													8403	8,403
6															
7															
8															
9	Custom Work														30
10	Gas Tax, Co-op & etc. Refunds			30											
11	Gov't Payments					2755							114		5,214
12	Other Farm income		916	329	1100										
13	Other Farm income														
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)		2237	692	1100	2755							114	8403	15,301
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income						5000								5,000
18	TOTAL CASH INFLOW (Add 14 thru 17)		2237	692	1100	2755	5000						114	8403	20,301
	EXPENSE SOURCE					ESTIMATED TOTAL CASH OUTFLOW									
19	Feed Purchased								200	200					400
20	Hired Labor					46	160	30				42			402
21	Farm Fuel		30	17	77										
22	Auto Expense					26	300		100		143				1,207
23	Machine Repairs			65	573								20	30	50
24	Machine Hire														
25	Livestock Expense					1100	730								1,830
26	Fertilizer						937		677						1,614
27	Crop Expense														
28	Utilities														
29	Farm Dues & Fees													150	150
30	Real Estate and Personal Property Taxes														
31	Cash Rent												125		125
32	Interest														160
33	Insurance			160											
34	Repairs on Permanent Improvements														
35	Other Farm Expense					1172	2127	30	977	200	143	42	145	180	5,938
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		30	242	650										
37	Purchased Livestock														800
38	Purchased Machinery and Capital Improvements		800			1172	2127	30	977	200	143	42	145	180	6,738
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		830	242	650	1583	450	450					450	450	5,690
40	Family Living Expense		1407	450	450										
41	Other non-farm expense														
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		2237	692	1100	2755	2577	480	977	200	143	42	595	630	12,428
						SUMMARY OF CREDIT NEEDS									
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)		----	----	----	----	2423	(-480)	(-977)	(-200)	(-143)	(-42)	(-481)	7773	7,873
44	Cash Available, beg.of period (prev.end of per.)	xxxx	----	----	----	----	----	2423	1943	866	666	523	481		6,902
45	Total Cash Available (Add 43 + 44)	xxxx					2423	1943	866	666	523	481		7773	14,675
46	Borrowing Necessary to Maintain $ balance														
47	Payment on Principal														
48	Total Current Debt (prev. period debt + 46 - 47)														
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx					2423	1943	866	666	523	481		7773	14,675

Extension Service, K. S. U.

C. CASE STUDY FARM NUMBER THREE

1. Whole Farm Analysis of A Sprinkler Irrigation System

This system has been in operation only one year. The positive net worth change is due to partner contributions to the business. The lower gross income is due to being out of the cattle feeding business for half the year and from poor yields of fall harvested crops.

Even with the added return on 130 acres of irrigated crops the gross income per crop acre was down from 1969 reflecting the poor yields for fall harvested crops. The costs per crop acre increased nearly $2 per acre due to the added irrigation expense. This operation is in a transition period. The transition from dryland to irrigation may cause the manager to change his farming patterns. It may also cause him to hold back on some phases of his operation (as this farm did with cattle) for a time to allow him to get the new enterprise in operation. Many fixed costs continue for the whole farm while the transition is taking place. The returns are delayed until the manager can get the new and old enterprises coordinated and in full operation. This seems to be the case with this farm and is reflected in the cost of $106.80 to obtain $100 gross income. Table 74 compares 1969 and 1970 financial summary for case study farm number three.

TABLE 74.--WHOLE FARM FINANCIAL SUMMARY

OF CASE STUDY FARM NO. 3

	1969			1970		
	ASSETS	LIABILITIES	TOTAL	ASSETS	LIABILITIES	TOTAL
Livestock	88,114					
Crops & Supp.	24,000			25,451		
Machinery	16,594			54,976		
Cash & Accounts Receivable	1,800			1,500		
Land & Bldgs.						
Short Notes		64,091			16,872	
Intermediate		17,857			13,222	
Long Notes						
Net Worth		48,560				51,833
Livestock	(Accrual)					
Income			51,793			36,203
Crop Income			30,164			16,657
Total			81,957			52,860
Irr. Expense			298			7,273
Total Expense			66,267			56,461
Irr. Capital Purchases			19,008			1,315
Total Depreciation			7,307		6,700	
Net Income For Labor, Land Equity and Management			8,383			(-3,601)
Total Crop Acres			1,100			1,527
Total Irr. Acres						130
No. Men			2.1			2.2
Man Work Days			923			1,018
Man Work Days Irrigation			---			108.20
Gross Crop Value/ Acre			52.02			50.60
Total Crop Cost Per Acre			27.29			29.20
Total Exp. Per $100 Gross			89.68			106.80

2. Cash Flow Study Number Three

This sprinkler system is on rented land operated by a partnership. All operator share of raised crops are fed to livestock so the cash flow reflects the crop sales at cash market prices when the livestock are marketed. The landlord furnished the well and pump. The operator owns the sprinkler system and power unit. No income from irrigation was taken in 1969 since the system was developed in the fall. Rye irrigated by the system was pastured during the fall of 1969 and the winter of 1970. Grain sorghum was grown in 1970. None of the milo harvested was sold in 1970, since it will be fed to livestock that will be sold in 1971.

No family living has been drawn from the irrigation enterprise yet. Cash irrigation inflow for the two years is $25,270 less than cash irrigation outflow. This is due to the inventory of 1970 production not yet sold and the initial development costs incurred. About $13,000 worth of grain sorghum was on inventory January 1, 1971.

TABLE 75.

CASH FLOW 1969 - Development Year
NAME Case Study No. 3 Date Prepared Post

		Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE		ESTIMATED TOTAL CASH INFLOW												
1	Livestock:														
2															
3															
4															
5	Crops:														
6															
7															
8															
9	Custom Work														
10	Gas Tax, Co-op & etc. Refunds												4		4
11	Gov't Payments														
12	Other Farm income - Not From Irrigation Operation -	Internal Generated						450	50	1700					2,200
13	Other Farm income														
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)							450	50	1700			4		2,204
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income														
18	TOTAL CASH INFLOW (Add 14 thru 17)							450	50	1700			4		2,204
	EXPENSE SOURCE		ESTIMATED TOTAL CASH OUTFLOW												
19	Feed Purchased														
20	Hired Labor														
21	Farm Fuel										52			22	74
22	Auto Expense								40		10	4	4	5	63
23	Machine Repairs											25			25
24	Machine Hire														
25	Livestock Expense														
26	Fertilizer														
27	Crop Expense											111			111
28	Utilities							10		4		4	4	3	25
29	Farm Dues & Fees														
30	Real Estate and Personal Property Taxes														
31	Cash Rent														
32	Interest														
33	Insurance														
34	Repairs on Permanent Improvements														
35	Other Farm Expense														
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)						---	50	---	66	144	8	30		298
37	Purchased Livestock														
38	Purchased Machinery and Capital Improvements						450	---	1700	15280	1114	-	464		19,008
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)						450	50	1700	15346	1258	8	494		19,306
40	Family Living Expense														
41	Other non-farm expense														
42	TOTAL CASH OUTFLOW (Add 39 thru 41)						450	50	1700	15346	1258	8	494		19,306
			SUMMARY OF CREDIT NEEDS												
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)						---	--	----	(-15346)	(-1258)	(-4)	(-494)		(-19302)
44	Cash Available, beg.of period (prev.end of per.)	xxxx					---	--	----	-----	1654	396	392		23,442
45	Total Cash Available (Add 43 + 44)						---	--	----	------	396	392	392		1,080
46	Borrowing Necessary to Maintain $ balance						---	--	----	17000	----	---	464		17,464
47	Payment on Principal														
48	Total Current Debt (prev. period debt + 46 - 47)						---	--	----	17000	----	---	17464		
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx					---	--	----	1654	396	392	392		2,834

TABLE 76.

CASH FLOW PROJECTION 19 70
NAME Case Study No. 3 Date Prepared Post

		Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE					ESTIMATED TOTAL CASH INFLOW								Head	
1	Livestock Pasture:											1464	(12¢ X 12200	Days)	1,464
2															
3															
4															
5	Crops: Rye Seed														
6														255	255
7															
8															
9	Custom Work													25	25
10	Gas Tax, Co-op & etc. Refunds														
11	Gov't Payments								840						840
12	Other Farm income - Not From Irrigation Operation						3000								11,100
13	Other Farm income				8100										
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)				8100		3000		840			1464		280	13,684
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income														
18	TOTAL CASH INFLOW (Add 14 thru 17)				8100		3000		840			1464		280	13,684
	EXPENSE SOURCE					ESTIMATED TOTAL CASH OUTFLOW									
19	Feed Purchased														
20	Hired Labor		21			16									37
21	Farm Fuel			76				79	12	130	260		45	60	662
22	Auto Expense		2		3										
23	Machine Repairs					17	3	9	--	22	6	5			73
24	Machine Hire									94					94
25	Livestock Expense														
26	Fertilizer							1672		737					2,409
27	Crop Expense			15				55				105	2500	105	2,780
28	Utilities														
29	Farm Dues & Fees		40												40
30	Real Estate and Personal Property Taxes													205	205
31	Cash Rent				733										733
32	Interest				204										204
33	Insurance														
34	Repairs on Permanent Improvements														
35	Other Farm Expense														
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)		63	97	940	33	3	1815	12	983	266	110	2545	370	7,273
37	Purchased Livestock														
38	Purchased Machinery and Capital Improvements					463		852							1,315
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)		63	97	940	496	3	2667	12	983	266	110	2545	370	8,552
40	Family Living Expense														
41	Other non-farm expense														
42	TOTAL CASH OUTFLOW (Add 39 thru 41)		63	97	940	496	3	2667	12	983	266	110	2545	370	8,552
						SUMMARY OF CREDIT NEEDS									
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)		(-63)	8003	(-940)	(-496)	2997	(-2667)	828	(-983)	(-266)	1354	(-2545)	(-90)	5,132
44	Cash Available, beg.of period (prev.end of per.)	xxxx	392	329	8322	7392	6896	9893	7226	8054	7071	6805	8159	5614	76,163
45	Total Cash Available (Add 43 + 44)	xxxx	329	8322	7392	6896	9893	7226	8054	7071	6805	8159	5614	5524	81,294
46	Borrowing Necessary to Maintain $ balance														
47	Payment on Principal				5000										5,000
48	Total Current Debt (prev. period debt + 46 - 47)		17464	17464	12464	12464	12464	12464	12464	12464	12464	12464	12464	12464	
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx	329	8322	7392	6896	9893	7226	8054	7071	6805	8159	5614	5524	81,294

D. CASE STUDY FARM NUMBER FOUR

1. Whole Farm Analysis of A Sprinkler Irrigation System

Since this case study is on the same farm as case study number two the whole farm analysis will not be repeated.

2. Cash Flow Study Number Four

This system was developed in 1970. One hundred and thirty acres of corn was grown on it and part (7540 bushels) was sold as a cash crop in 1970. The remaining 8737 bushels were sold in 1971. It is on a rented quarter section of land. The operator paid all development costs, but has a long term lease. This system is located on the same farm unit as case study number two. Unsold inventories of grain and the initial development costs have caused the irrigation sales inflow to be $30,081 less than outflow for irrigation. No family living was realized from this operation in 1970. After the remaining corn was sold in 1971 for $12,232 the total irrigation outflow for 1970 exceeded income from production on irrigated acres by $17,849. This means that all variable expenses for 1970 were repaid and $10,062 of the $27,911 capital investment made in 1970 was repaid. At this rate of recovery and assuming no withdrawals for family living, income taxes or social security taxes the capital investment recovery will take less than three years from the time of the first investment was made. The validity of the assumption that the sprinkler irrigation will not partially support the operator's family and pay its share of the taxes may be open to careful review in actual practice. This example serves to show what the minimum payback possible could be on a well managed irrigation unit if it is heavily financed externally.

TABLE 77.

CASH FLOW 1970
NAME Case No. 4 Date Prepared Post

		Total Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	INCOME SOURCE						ESTIMATED TOTAL CASH INFLOW								
1	Livestock:														
2															
3															
4															
5	Crops:													10556	10556
6															
7															
8															
9	Custom Work														
10	Gas Tax, Co-op & etc. Refunds														
11	Gov't Payments													629	15018
12	Other Farm income						9457	4995							
13	Other Farm income														
14	TOTAL FARM CASH INFLOW (Add 1 thru 13)						9457	4995						11185	25637
15	Non-farm business, wages, etc.														
16	Non-farm dividends & interest														
17	Other non-farm income						5000			5000					10000
18	TOTAL CASH INFLOW (Add 14 thru 17)						14457	4995		5000			11185		35637
	EXPENSE SOURCE						ESTIMATED TOTAL CASH OUTFLOW								
19	Feed Purchased														
20	Hired Labor						75	60	301	195	210				841
21	Farm Fuel						42		100	200	140				482
22	Auto Expense						2729			50			15		2794
23	Machine Repairs														
24	Machine Hire						1566	897	211						2674
25	Livestock Expense						1172		822						1994
26	Fertilizer														
27	Crop Expense														
28	Utilities														
29	Farm Dues & Fees									45					45
30	Real Estate and Personal Property Taxes													3400	3400
31	Cash Rent												481		481
32	Interest											15			15
33	Insurance														
34	Repairs on Permanent Improvements														
35	Other Farm Expense						5584	957	1434	490	350	15	496	3400	12726
36	TOTAL CASH OPERATING EXPENSES (add 19 thru 35)														
37	Purchased Livestock						23873	4038							27911
38	Purchased Machinery and Capital Improvements						29457	4995	1434	490	350	15=	496	3400	40637
39	TOTAL FARM CASH OUTFLOW (Add 36 thru 38)														
40	Family Living Expense														
41	Other non-farm expense						29457	4995	1434	490	350	15	496	3400	40637
42	TOTAL CASH OUTFLOW (Add 39 thru 41)														
							SUMMARY OF CREDIT NEEDS								
43	NET CASH FLOW (+ or -) (Sub. 18 - 42)	xxxx					(-15000)		(-1434)	4510	(-350)	(-15)	(-496)	7785	(-5000)
44	Cash Available, beg.of period (prev.end of per.)	xxxx								3566	3076	2726	2711	2215	14294
45	Total Cash Available (Add 43 + 44)						(-15000)		(-1434)	8076	2726	2711	2215	10000	9294
46	Borrowing Necessary to Maintain $ balance						15000		5000						20000
47	Payment on Principal									5000				10000	15000
48	Total Current Debt (prev. period debt + 46 - 47)						15000	15000	20000	15000	15000	15000	15000	5000	
49	CASH BALANCE, END OF PERIOD (45 + 46 - 47)	xxxx							3566	3076	2726	2711	2215		14294

E. SUMMARY OF CASE STUDY FINANCIAL ANALYSIS AND CASH FLOWS

Examples of irrigation units that were developed with sizeable amounts of borrowed capital were purposely selected to contrast with irrigation units developed primarily with internally generated capital to exhibit the flow of funds and the effect on family living. Several detailed analysis techniques will be outlined in Chapter VI to review the advisability of undertaking an irrigation enterprise. These techniques are valuable for the long run, but the projected cash flow in particular helps the developer to determine the payback terms possible if borrowed funds are involved. It also allows the developer to see how much money will be available for family living and other non-irrigation outflow. Case study number one showed that in the first two years of irrigation production only $3718 could be taken for family living for two families. No note payment was made in the first 30 months after initiation of irrigation development. In the third year of operation the family living withdrawal was $9001 for the two families. Note repayment of $10,080 and family living of $12,187 was possible in the fourth year of development. This suggests that possible irrigation development and early operating capital, if borrowed, should be set up on an intermediate term note and certainly not on an equal payment of principal basis. The farm operator needs adequate time to learn how to utilize irrigation for maximum production. A livestock-crop operation similar to case study number one and two needs more time than a cash crop farm similar to case study number two and four. This is because of the time it takes to market the irrigation production through the livestock.

Case study number three showed that with the relatively high input costs connected with irrigation that average or lower value production will not be high enough to give the operator a profit for his labor and management. This is not unusual, however, for a beginning operator.

CHAPTER VI

USE OF PROJECTED CASH FLOWS IN INVESTMENT PLANNING

Cash flows may be used as a basis for several useful credit analysis tools. Among these are the payback, simple rate of return, and discounted cash flow.

A. PAYBACK METHOD

The payback method is one of the most used, but probably one of the most lacking in analytical depth. It is a method of balancing total outflow and total inflow of funds over time. Many investors will decide to proceed with their plans if the total payback is more than the total outflow in a reasonable period of time.

Case study number two would show that it took less than two years to pay off the original development cost and subsequent operating costs from production income ($38,382) when no land expense or operator labor and investment return was taken out. When withdrawals for family living were considered in the flow of cash there had not been full recovery of the outflow of funds for development and operation over the three years it had operated. In fact, this example of payback analysis was short $13,861 of inflow. Another way to view this, would be to say that the operator over a three year period (1968-70) had paid all operating expenses totaling $20,626 drawn $18,530 for family living, paid nothing on the capital investment (100% his own equity) and found it necessary to pull in $774 from other enterprises on this farm unit. Over half the 1970 corn crop is still on inventory, hence not yet recorded as a return to irrigation operations.

"The payback period has some serious weaknesses as a measure of investment worth. It can lead to incorrect ranking of investments and can suggest unsound decisions.

One major limitation of the payback is that it fails to consider the entire economic life of the investment proposal -- it ignores profits earned after the initial investment has been recovered. Suppose we are considering two investments, each costing $10,000 and each returning a cash inflow of $3,000 a year. Further assume that the first is expected to provide earnings for ten years, the second for five years. Both would pass equally well the requirement of a five-year payback, while the first investment obviously is the better investment.

Strictly applied, the payback period is not a measure of profitability. Since it considers how quickly investment dollars may be recouped, it is really a measure of liquidity. The main objective of making an investment is profitability, not merely recapturing the original outlay. To carry it to the absurd, if we were really interested in a short payback, a businessman wouldn't invest his funds at all -- the payback time would be zero. Of course, businessmen who use the payback method as a guideline do not apply the measure as blindly as the above discussion infers. They recognize that given the payback period, the longer the expected useful life of the asset, the greater the profitability. But if a measure of investment worth that allows management to consider the entire economic life of the investment is available -- and it is -- why not use it rather than the payback?

The payback period method has another serious defect as a measure of the economic worth of investment alternatives. The establishment of the cutoff criterion -- the maximum acceptable payback -- is usually an entirely subjective decision. Except under certain conditions usually not met in practice, the establishment of the maximum acceptable payback has no objective basis and no necessary relation to the assumed primary objective of the business to maximize the economic well-being of the owners.95/

95/ Richard D. Aplin and George L. Caster, Evaluating Proposed Capital Investments With Discounted Cash Flow Methods, 2nd edition, Department of Agricultural Economics, Cornell University, Ithaca, New York, 1969, p. 5-7.

A third weakness of the payback period as a measure of investment worth -- and one that can suggest incorrect decisions to management -- is the fact that it fails to consider the timing of the cash outflows and inflows. It ignores the fact that a dollar in hand today is more valuable to us than a dollar that we will receive sometime in the future. As discussed later, most businessmen have one or more reasons for preferring a dollar today over a dollar sometime in the future. Consequently, to make valid comparisons between the capital outlays required by an investment and the resulting benefits (added cash inflows in the future years) management must attempt to reflect the time value of money.

Although the payback period has some serious limitations, some favorable things can be said of it. The payback is certainly superior to the urgency approach. It required conscious estimates of capital outlays and of annual cost savings or expected additions to revenue--which is a crucial step in any analysis of investment alternatives. It is simple. It is a conservative measure that may have particular usefulness when a firm is extremely short of cash or credit ability or when the project being analyzed carries extreme risk of obsolescence. The payback can be used as a coarse screen to identify obviously desirable investments (e.g., an investment that can be expected to have a productive life many, many times its payback period) and obviously undesirable investment (e.g., a project whose payback period is as long as its expected useful life). Although prudent use of the payback period as a measure of investment worth may be helpful to management, it has serious shortcomings as the primary measure of

the desirability of investment proposals.

B. SIMPLE RATE OF RETURN METHOD

The simple rate of return method is a fairly common analytical investment tool best shown by:

$$R = \frac{E - D}{C}$$ where:

R = the average annual rate of return.
E = the additional average annual earnings, before depreciation, expected from the investment.
D = the additional average annual depreciation.
C = the amount of capital required by the investment.

This writer found that Federal Land Bank credit analysis presently utilitizes this analytical tool in its loan counseling.

To arrive at a return for the irrigation investment only the formula is used with values for the land, operator labor and operator management are assigned. The average annual land charge is assigned at the rate of $24 per acre or $2400 per year for the 100 acre unit. The operator labor and management is assigned at a rate of ten hours per acre times three dollars per hour or $30 per acre or $3000 per year for the total unit. The additional $8610 worth of corn unsold in 1970 is also added to (E).

E = $2018 = total irrigated gross income of $46,992 minus average dryland gross of $18,000 minus difference between total irrigated costs (not counting depreciation and interest, but including $7200 land cost and $9000 labor) of $35,086 and $15,750 which is the average dryland costs for this farm all divided by 3 years equally additional average annual earnings.
D = $ 1,008
C = $13,087

The value for (R) or the average annual rate of return is:

$$R = \frac{\$2018 - 1008}{13,087} = 7.71\%$$

The simple rate of return is superior to the payback period as a measure of investment worth because it considers the added earnings of an investment over its entire expected useful life -- not merely the added earnings up to the payback date. But the simple rate of return has some serious limitations also. One of its weaknesses is that the rate of return computed is not directly comparable to figures used in the financial world in quoting interest rates on borrowed funds, yields on bonds and the like. Such rates are usually computed on the basis of capital in use from year to year rather than on average or initial investment. Thus it does not permit the direct comparison of projected returns on investments with the cost of borrowing money or with the returns that might be obtained on ownership capital if invested in financial securities.

A second limitation of the simple rate of return, and one that can be serious in some instances, is that it fails to take into consideration the timing of the capital outlays and benefits. Since this measure of investment worth does not enable management to reflect that a dollar invested in a project today is more valuable than a dollar of benefits to be received sometime in the future -- a weakness of the payback period method also -- it can suggest incorrect decisions to management. This can occur particularly when the earnings or savings from an investment are likely to start at a relatively low level but increase significantly over time (e.g., a new product or new enterprise).

In such a case, an investment could have an acceptable average rate of return but still be undesirable when the time value of money is considered. Discounted cash flow calculation of rate of return takes into account the timing of capital outlays and benefits.

C. DISCOUNTED CASH FLOW METHOD

The discounted cash flow method of analysis is probably the least used, the least clearly understood and the most powerfully analytical of the three tools being used by business today. Richard D. Aplin and George L. Caster of Cornell University have done an excellent job of describing this system in their paper, Evaluating Proposed Capital Investments With Discounted Cash Flow Methods. Much of this description will be drawn upon to explain its use in evaluating case study number two.

> "(1) The two measures of investment worth most widely used by businessmen, the payback and simple rate of return, suffer from serious weaknesses and can suggest incorrect decisions.
>
> (2) A dollar received at some future date is worth less than a dollar in hand today.
>
> (3) Therefore, no sums of money are comparable unless the comparison is made at the same point in time.
>
> (4) The use of discounted cash flow methods requires that all relevant financial information be converted to actual cash flows (money receipts and payments), and that information which has no effect on cash flows be ignored."96/

Two measures of investment worth that allow managers to reflect these concepts may now be considered. These measures, both of which are called "discounted cash flow methods," are : (1) the net present

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96/ Ibid., p. 26.

value method and (2) the yield of investment or discounted rate of return method. The underlying logic and the mechanics of these two measures will be explained in succeeding pages using simple, hypothetical investment proposals as illustrations.

D. NET PRESENT VALUE METHOD OF EVALUATING INVESTMENT

The net present value method of evaluating an investment, which allows management to reflect the time value of money, involves four steps. Each step will be explained and will be applied to a simple illustrative investment.

The first step involves the determination of an "appropriate" discount rate. The discount rate should reflect the minimum acceptable rate of return. Under most conditions, it can be argued that the appropriate discount rate is an estimate of the firm's "cost of capital". Some decision makers use different discount rates for different classes of expenditures to reflect differences in the degree of risk involved. The discount rate chosen by the decision maker represents the "cut off criterion" in judging whether or not an investment is desirable. Consequently the selection of the "correct discount rate" by management is of crucial concern.

The next step involves computing the present value of the net cash inflows -- the benefits -- that are expected to result if the capital expenditure is made. The present value of the net cash inflows (or net cash proceeds of an investment) discounted at the firm's cost of capital represents the maximum amount that a firm could afford to pay for the opportunity of making the investment without being financially worse off. This interpretation of the present value of the net

cash inflows is crucial to understanding the net present value method.

The third step in the net present value method involves computing the present value of the cash outlays required by the investment. All of the capital outlays associated with some investments occur immediately, in which case the present value of the outlays is merely the net amount of additional capital needed if the investment is made (i.e., the present value of a dollar expended today is $1.00).

In the fourth step, the present value of the capital outlays -- as determined in Step 3 -- is subtracted from the present value of the net cash inflows -- as determined in Step 2. The difference is referred to as the net present value of the investment.

Criterion for Acceptance or Rejection. Management should accept all independent investments that have positive net present values and reject as undesirable all investments that have a negative net present value. This criterion for judging the desirability of investment proposals is based on the fact that the present value of net cash inflows when discounted with the cost of capital represents the maximum amount that the investor could afford to pay for the benefits expected and just "break even" (Step 2). If an investment has a positive net present value, it means that the investor could afford to pay more than the current cost of the assets. Alternatively investment with a positive net present value may be said to yield a return greater than the rate of return used as the standard in testing the proposal. On the other hand, if an investment proposal has a negative net present value, it would seem undesirable from an economic viewpoint because the investment outlays required exceed the maximum

amount the firm could afford to pay without being financially worse off (i.e., the present value of the benefits expected).97/

There are a few exceptions to this criterion -- for example, in the case of "mutually exclusive investment" (i.e., for some reason(s) only one of two or more investments can be undertaken) or in the case of capital rationing. Under these conditions the major good may be to minimize losses.

The net present value method expressed in formula form is:

$$V = \frac{A_1}{(1+r)} + \frac{A_2}{(1+r)^2} + \ldots + \frac{A_n}{(1+r)^n} + \frac{S}{(1+r)^n}$$

where: V = present value of net cash inflow, A_1, $A_2 \ldots A_n$ = cash inflow after taxes in years 1, 2, ...n,

r = the discount rate or cost of capital,

n = expected economic life of asset,

and S = salvage value of the asset in year n.

If V exceeds C, the investment appears desirable, where

C = the capital expenditure required or the cost of the asset.

To illustrate the net present value methods; assume that, as in case study number two in 1968, it was considering an irrigation investment which would require a total capital outlay of $13,087, produced net cash inflows over operating costs of $5,671 in 1968, $9,072 in 1969, $2,627 in 1970 and estimated $5,500 for the next seven years. Again no cost for land, operator labor and management, risk or return to investment is figured in the operating costs.

When a nine percent discount rate to reward development invest-

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97/ Ibid., p. 18-20.

ment is used, after costs for labor and management and costs for land are assumed at customary local rates a net present value of investment of $-965.41 is derived. The land was appraised at $300 per acre and given an eight percent annual production return to investment or $24 per irrigated acre. Labor and management cost was figured at $3 per hour for 10 hours per irrigated acre or $30. The $8610 inventoried corn was added to the third year's income. The discount factor of nine percent results in a negative annual present value of income. This illustration makes a weaker case for undertaking the irrigation investment. Table 78 shows the calculation to arrive at the return above all costs except return to investment on a net present value method. The projected CASH INFLOW and ACCRUAL INCOME figures after the third year is an estimate which is probably lower than would normally be expected for this operator. When labor and land is charged at the above costs a nine percent discount factor may be higher than normally expected also. The factors have to be carefully evaluated by the manager when he is making an analysis of a proposed capital expenditure.

E. YIELD OF INVESTMENT METHOD

The yield of investment approach involves finding the rate of interest that will make the present value of cash inflows expected from an investment equal to the present value of the cash outlays required by the investment. This is a trial and error method basically using the net present value method to find the discount rate that yields a net present value of investment of zero. When this discount rate is found it represents the highest rate of interest an investor could afford to pay, without losing money if he is borrowing all the

capital and the investment must repay principal and interest.

Again, operator labor, management return and a risk factor should be valued and deducted before cash inflows are determined unless they are included in the discount rate chosen.

Variations of these analytical tools may be used to analyze prospective investments. This method has the major advantage over payback period and simple rate of return methods in that it considers time. The value of a dollar in hand today should be more than it will be in the future. This technique allows this factor to be considered in depth. It still demands the investor's judgment and a certain amount of educated guesswork when projecting future costs and returns.

TABLE 78.--CALCULATIONS FOR CASE STUDY FARM NUMBER TWO ON NET PRESENT VALUE OF CAPITAL INVESTMENT

(Investment Only)

YEAR	ACCRUAL INCOME		9% DISCOUNT FACTOR		PRESENT VALUE OF INFLOWS
1	$ 271	X	.9174	=	$ 248.61
2	3,672	X	.8417	=	3,090.72
3	5,837	X	.7722	=	4,507.33
4	1,100	X	.7084	=	779.24
5	1,100	X	.6499	=	714.89
6	1,100	X	.5963	=	655.93
7	1,100	X	.5470	=	601.70
8	1,100	X	.5019	=	552.09
9	1,100	X	.4604	=	506.44
10	1,100	X	.4224	=	464.64
Present value of net cash inflows				=	12,121.59
Minus present value of capital outflows				=	13,087.00
Net present value of investment				=	(-965.41)

CHAPTER VII

CAPITAL NEEDS AND SOURCES

A. PROJECTED CREDIT NEEDS FOR IRRIGATION IN SOUTH-CENTRAL KANSAS

Kansas Water Resources Board has projected a doubling of irrigation acreage between 1968 and 1980 to a total of 166,700 acres from 80,000 acres in the 11 counties in this study. It will be assumed here that the Board's projection is correct if all conditions are met successfully, including capital requirements. How much capital investment will be needed and from where will it come?

It is assumed this expansion will be done on an average of 7,225 acres per year or a nine percent annual growth. Some will be sprinkler and some will be flood irrigated. The easiest flood irrigation development has probably taken place. However, there will continue to be acreage developed for flood irrigation but probably at a slower rate than in the past. Sprinkler irrigation in contrast is expected to expand in its rate of development since the rolling sandy land suitable for irrigation in the area is only beginning to be irrigated. This coupled with more suitable equipment that saves labor will encourage greater use of sprinkler systems in the area.

If 1968 - 1970 costs of development were to be projected through 1980 the development formula would be:

$$ADC = \left[(S \times SDC) + (F \times FDC)\right] \left[(PI)\right] \text{ where:}$$

ADC = Annual Development Cost.
S = Acres of sprinkler irrigation developed annually.
F = Acres of flood irrigation developed annually.
SDC = Sprinkler development cost per acre.
FDC = Flood development cost per acre.
PI = Price index (1968 - 1970 = 100).

The following estimates for the formulas have been chosen on the basis of trend analysis and knowledge of the most likely direction the forms of irrigation will take in the future from the data in Chapter I - VI and the costs and returns exhibited in the Farm Management Association study and case study farms.

S = 5060 acres (70% of each year's development)

F = 2165 acres

SDC = $210
FDC = $140 (Average cost of South-Central Kansas area case studies and the Demonstration Farms in Harvey County.)

This gives an annual new investment figure calculated as follows:

$$ADC = [(5060 \times \$210) + (2165 \times \$140)][(100)] = \$1,365,700$$

If prices were to increase six percent annually from 1970 the ADC by 1980 for 7,225 acres would be:

$$ADC = [(5060 \times \$210) + (2165 \times \$140)][(1.7908)] = \$2,445,695$$

The expected operating costs by 1980 for the 166,700 acres would be found by the formula:

$$AVC + [(S \times SVC) + (F \times FVC)][PI]$$

where all notations mean the same as before and in addition:

AVC = Annual variable costs

SVC = Sprinkler variable costs

FVC = Flood variable costs

When the following values are used from the data in Chapters I - VI the total operating costs can be determined.

AVC = (113,356 X $47) + (53,344 X $57) (100) = $8,366,673

If prices were to rise by six percent per year the AVC by 1980 would be:

AVC = (113,356 X $47) + (53,344 X $57) (1.7908) = $14,983,800

This is about two and one-half times the variable costs of dryland farming in the area or a total of $5,020,000 for irrigation over dryland with no price change. If prices go up by six percent per year to 1980, it would take $8,989,816 for operation of irrigated land over dryland farming.

The total annual irrigation operating capital and new investment in irrigation development needed for 1980 would be nearly $9,732,000 for the 11 county area at no price change and $17,429,500 if prices were to move up six percent annually between 1970 and 1980. Total new money needed annually over and above dryland is estimated to be $6,400,000 to $11,435,500 depending on rates of inflation.

B. CAPITAL SOURCES - A REVIEW OF THE TERMS AVAILABLE, APPLICATION PROCEDURES AND CAPITAL RESTRAINTS

It is evident from the case studies presented in the last chapter that a prospective irrigation farmer may need to consider all available sources of capital for irrigation development. In Chapter I, it was pointed out that capital is of two types in the eyes of the manager. Equity or his own business's capital and outside capital.

Equity capital in the aggregate makes up the largest share of the total in agriculture, but may not on a specific farm. It comes from net farm income, non-farm income, or gift or inheritance. In the latter category, young men are advised as follows:

> "If possible, marry the only child of a farmer who has two farms - so he can give you one and continues to farm the other one if he wants to. Opportunities in this area are

severly limited, unfortunately."98/

Market value of equity capital can be increased by inflation. This is often important in equity in land. Inflation can be favorable to those who own the land that has increased in value but unfavorable to those who are buying it and must pay higher prices. It also allows a basis for additional credit.

Other means of acquiring use of capital resources are:

1. Renting land
2. Leasing machinery
3. Hiring custom operations

Of the outside sources of capital, borrowing is the one of most concern in this paper so little more will be said of the other techniques.

A loan is "an investment of credit in a farm business that (1) will be profitable to the creditor, (2) will augment the borrower's efficiency, income, and productivity and (3) will be paid in full when due."99/

1. Equity

a. General Ability To Meet Expanding Capital Needs

Internally generated savings is the largest source of investment capital for U. S. farmers. Savings come from production that has

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98/ J. R. Brake, C. L. Beer, M. P. Kelsezy, E. B. Hill, J. M. Nielson, and M. E. Wirth, Farm and Personal Finance, Michigan State University Press, East Lansing, Michigan, October 12, 1961, p. 13-14.

99/ Bob Rethorst, guest lecturer in Dr. Orlo Sorenson's Agriculture Finance class in Summer 1968.

not been consumed, but has been saved in one form or another by the operator for use in future production.

Annual cash receipts from marketings of farm commodities increased more than 400 percent between 1940 and 1965, but total funds available annually for investment increased only 60 percent from $5 billion in 1940 to $8 billion in 1965. Clearly, a problem exists for the farmer because his capacity to generate cash flow out of sales earnings has not increased nearly as fast as his needs for purchased inputs and investment in the farm business.100/

Hopkins & Fry have indicated the following major problems to agriculture in generating its own capital needs:

> "1. Declining rate of capital generation in relation to needs.
> 2. Intergeneration transfers.
> 3. Dominance of the properietorship form of firm organization."101/

Equity capital will remain the major source of farm capital, but in relative terms it is expected to decline as percentage of the total in the future.

Table 80, a comparison of Farm Management Association farms' equity in 1968 and 1969 may be with table 79. Both show the total debt and total assets increasing. Note that owner-operator equity increased from 1968 to 1969 for both real estate and non-real estate assets. This is contrary to long term trends. Higher than average

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100/ Loc. cit., Food and Fiber Report, p. 235.

101/ John Hopkins and Thomas Fry, Financing Agriculture in The Great Plains, paper presented at Great Plains Resource Economic Committee, Laramie, Wyoming, September 1970, p. 9.

farm incomes in 1969 for the 11 county area were given the credit for causing this boost in percentages.

2. Evaluation Of Credit Sources In Relation To Expected Payback Capacity Of The Irrigation Unit On The Cash Flow Basis And The Financial Institutions's Capacity To Fill The Needs

A concern of those who study the future credit needs of agriculture is whether agriculture will be able to obtain its needed share of capital from credit markets with the vast amount needed to fulfill the requirements of non-agricultural sectors.

"It has been estimated, for example, that municipal government and mortgages will require roughly twice as much credit during the next five years as they did in the last five years."102/ It is felt that for agriculture to maintain or increase its share of the total borrowed capital it will have to use more skill, be more competitive, more efficient and more resourceful than it has in the past.

Henderson is quoted as follows on trends in borrowed credit that are expected and will possibly affect the course that the good strategist in farm management and agricultural credit will take include:

"1. Repayment of more specialized loans will be slower because intermediate and long-term contract purchases will be commonplace in the financial picture of our bigger and more specialized farm loans.

2. Lending will be done (in the 70's) primarily on the basis of repayment.

3. Lenders will spend their time 'where the action is' . . . with the big farmers.

102/ J. Phil Campell, Remarks, from the 19th Agricultural Credit Conference, Marriott Motor Hotel, Atlanta, Georgia, November 15-17, 1970, p. 1.

TABLE 79.--FARM DEBT OUTSTANDING JAN. 1,

AND ANNUAL CHANGE, 1960-70 a/ c/

YEAR	Debt outstanding Jan. 1			Change in debt during year					
				Dollar change			Percentage change b/		
	Total	Real estate	Non-real estate	Total	Real estate	Non-real estate	Total	Real estate	Non-real estate
	Billion dollars	Billion dollars	Billion dollars	Billion dollars	Billion dollars	Billion dollars	Billion dollars	Billion dollars	Billion dollars
1960	23.6	12.1	11.5	1.2	0.7	0.5	5.0	6.1	3.8
1961	24.8	12.8	12.0	2.0	1.1	.9	8.2	8.4	7.9
1962	26.8	13.9	12.9	2.9	1.3	1.6	10.7	9.1	12.3
1963	29.7	15.2	14.5	3.3	1.6	1.7	11.2	10.8	11.7
1964	33.0	16.8	16.2	3.0	2.1	.9	9.2	12.4	5.8
1965	36.0	18.9	17.1	4.1	2.3	1.8	11.5	12.1	10.8
1966	40.1	21.1	19.0	4.4	2.2	2.2	10.9	10.0	12.0
1967	44.5	23.3	21.2	4.5	2.2	2.3	10.0	9.4	10.6
1968	49.0	25.5	23.5	3.0	1.7	1.3	6.1	6.5	5.7
1969	52.0	27.1	24.9	3.4	1.3	2.1	6.7	4.7	8.8
1970	55.4	28.4	27.0	---	---	---	---	---	---

a/ Data for 48 States only. Excludes Commodity Credit Corporation loans.

b/ Computed from unrounded data.

c/ Source: Agriculture Finance Review, Vol. 31, Sup., Dec. 1970, Economic Research Service, U.S.D.A., Washington, D.C., p. 1.

TABLE 80.--AVERAGE OPERATOR EQUITY IN REAL ESTATE AND NON-REAL ESTATE ASSETS MANAGED, 406 FARM MANAGEMENT ASSOCIATION FARMS IN SOUTH-CENTRAL KANSAS, 1968 AND 1969

ITEM	DOLLARS		PERCENT OF TOTAL OWNED IN DOLLAR TERMS	
	1968	1969		
Real Estate				
Owned	$ 62,434	$ 68,868	100%	100%
Rented	116,459	121,900	----	----
Total Managed	178,893	190,768	----	----
Debt on Owned	17,084	16,988	27.40	24.66
Total Operator Equity	45,350	51,880	72.60	75.34
Non-Real Estate				
Total Managed	49,165	53,972	100	100
Debt Outstanding	18,772	20,383	38.18	37.81
Total Operator Equity	30,393	33,589	61.82	62.19
Total Managed	228,058	244,740	----	----
Total Operator Equity	75,743	85,469	67.87	69.60

NOTE: Value of Rent Land was derived by = Total Value Real Estate Managed X Percentage Acres Rented. This may reflect a bias toward excessively high value of rented land since owned land often has more valuable improvements than does rented. The direct value was not kept in the form above in the annual summary of association records.

4. If our competitors (PCA's and FHA) continue to move as they have in the past two or three years, they will take the banks out of agriculture by 1980."103/

Swackhamer adds:

1. "Traditional lenders will continue to provide the major share of commercial farm credit but new methods of funding will continue to materialize.

2. Commercial banks and insurance companies will lose a relative share of financing and Farm Credit lenders will continue to gain a relative share.

3. Greater reliance will be placed upon money and capital markets for additional funds to finance commercial agriculture.

4. Two basic conditions will prevail throughout much, if not all, of this decade:

   a. The competition for investment capital and operational credit will remain intense both among economic sectors and within sectors of our national economy.

   b. The supply of investment funds will be adequate to sustain economic growth but the demand pressures will limit any significant downward trend adjustment in intense rate levels."104/

It seems generally felt that intermediate credit, the type most important to irrigation development, will be the most difficult to supply adequately.

Edward Norman, Chairman of the Agriculture Committee of the American Bankers Association in 1969, said:

> "All told our greatest problem is the greater and greater capital needs, especially in the area of agriculture. One of

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103/ Joseph D. Henderson, Lets Make Dust - Not Eat It!, before the 18th National Agriculture Credit Conference of the American Bankers Association, Hotel Fort Des Moines, Des Moines, Iowa, November 17, 1969, p. 4.

104/ Gene L. Swackhamer, Capital Markets and Agricultures Future Access to Capital, presentation at Great Plains Resource Economic Committee, Laramie, Wyoming, September 30, 1970.

the greatest remaining source of loanable funds is the smaller community bank. This in my opinion reflects two things:

1. Agriculture is in much better shape as far as reinvested earnings and resultant debts are concerned than many industries.

2. Community banks are not using their initiative to be the financial center of the community and are willingly passing the farmer market to other lenders. The capital needs for the 70's are going to be so great that it will take all the money available to support it."105/

In spite of the increased debt since 1960, sizeable proportions of loans held by lenders are not large in relation to current property values and there is considerable potential to support additional debt in agriculture as an aggregate industry.

If all the farms adopting irrigation were like case study number two and four, the short term credit institutions would need to furnish about 40% of the capital at some time during the year or between $3 million and $4.6 million annually to the 11-county area.

If they were like the case study farm number one and three the short term lenders could expect to supply 40% to 60% of the capital depending on the year and how the production had been in the previous years. The intermediate and long-term suppliers could expect to get 75% to 100% of the initial development cost for at least up to the time of the first crop. In the eleven-county area this could range from $800,000 to $1,000,000 annual new investment by 1980 at stable

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105/ Edward M. Norman, Opening Remarks, before the 18th National Agricultural Credit Conference of the American Bankers Association, Hotel Fort Des Moines, Des Moines, Iowa, November 17, 1969.

prices or as much $1,956,556 to $2,445,695 if prices went up by six percent each year until 1980.

On the case study farms analyzed in this report, repayment on the development costs was begun one to three years after the loan was made and may be paid off in five to 15 years depending on other demands for the inflow of cash. This would tend to lower the total new money outstanding at any one time to something less than the total loan requirement figure shown earlier. If the loans were amortized over eight years the maximum outstanding borrowed capital for development in the 11-county area would be between $5,462,800 and $9,782,780. This assumes that all development funds are borrowed.

Operating capital is generally payed within the same 12-24 month period it is borrowed depending on whether the crop is sold as cash crop or fed to livestock. This assumes no crop failures due to disease, insects or hail. Most of the irrigated crops are fed in the 11-county study area. An expected crop loss factor would probably offset any amount of cash irrigated crop that does leave the area. Thus an estimated time turn around of two years on the operating capital needed to produce the irrigated crops and feed it to livestock which in turn are sold out of the area would be likely. The two-year supply of operating capital outstanding at any one time would total between $16,733,346 and $29,967,600 by 1980.

Operating costs and development costs tied directly to the 166,700 acres irrigated by 1980 would total $22,196,146 and $39,750,380. Again it is difficult to estimate how much of this would need to be financed by borrowed funds. The case study farms would indicate that

between $10,790,000 and $27,763,000 might be borrowed at any one time by 1980.

It is evident that the exact or even a very close range of possible credit needs can be calculated no more accurately than an educated estimate. It is evident that over 60% of this capital is new money needed that is not now available to dryland farming. Bank deposits will need to grow by a rate greater than 8.7% (58%, present loan to deposit ratio, times 15% (9% annual growth of irrigation development + 6% price increase of inputs) = 8.7%) if they expect to stay competitive. This assumes no increase in loan to deposit ratios or that other capital demands will not be reduced. Insurance companies and Federal Land Banks will need to grow also to offset the effects of higher-valued land due to irrigation development and for the development itself. PCA's will be pressured to pick up the slack if banks do not meet the challenge. Secondary enterprises, such as cattle feeding, hog operations and agri-business, will add to the demands for finances.

The nation's money supply is projected to grow at an annual five to six percent rate according to an August 1970 Federal Reserve Board announcement. This is subject to change at any moment. Whether agriculture gets a share and specifically if irrigation financing in South-Central Kansas gets a share of this increase in money is subject to many variables. It does indicate an effort to help supply the six percent price increase annually that is projected into the $13,317,000 capital demand for irrigation by 1980.

If banks were willing to use their extra liquidity by raising

their loan to deposit ratio from 57.65, as it was in June 1970, to say 65% and were loaning it all to irrigators and if the banks deposits did grow slightly; they could then meet the capital needs of the irrigators. This alternative seems somewhat optimistic with respect to the share of the total borrowing shared by irrigators and rather gloomy to bankers with respect to no new deposit growth.

On the basis of present trends, an increasing amount of development and operating capital for irrigation will come from borrowing. Banks deposits will grow and loan to deposit ratios will increase, but at a rate that will cause the banks to supply a smaller percentage of the total short-term and intermediate-term irrigation loans than now supplied. They will supply much less of a percentage of long-term capital by 1980 than they do now.

PCA's will grow in their capacity to supply needed capital. Federal Land Banks will grow at a slower pace as insurance companies come back into the long-term credit field after the 'money crunch' of the last few years.

Dealer credit, credit unions, public stock sales and direct borrowing from trusts, pension funds, endowments and individuals may be used by an increasing percentage of farmers as they become more credit sophisticated and capital hungry. This type of unsupervised borrowing holds some danger for both the lender and the borrower.

> "Farmers have been getting more of their real-estate loans in recent years from individuals and insurance companies, and fewer from Federal Land Banks, Farmers Home Administration, and commercial and savings banks.
>
> In fact, individuals have been furnishing more of farmer's real estate credit than the figures show. Through

increasing use of land sales contracts, which are often not included in farm debt figures, sellers provide real-estate credit on low downpayments to buyers who might not qualify for other types of loans. Many of these buyers are especially vulnerable to loss of their equity, even though this equity may be relatively small.

Surveys show that younger, less experienced farm operators, with lower incomes and fewer assets, tend to obtain their mortgage financing from individuals rather than lending institutions. These farmers need larger loans, in relation to their incomes and assets, than most institutional lenders are willing to give. Most individuals who extend credit to young farmers and to others are retiring farmers who, when selling, provide the buyers with much of the needed financing.

Farm incorporation provides opportunities for acquiring capital, while providing limited liability for stockholders. In many cases, a small corporation is taxed as if it were a partnership. Incorporation likewise provides opportunities for capable young managers to enter farming, and gradually acquire an increasing share of the farm business.

FHA should keep its concept of a small farmer current with the economic facts in agriculture and emphasize even more than it has loans to economic-sized farm units, and to reorganization of farm businesses to shift cropping patterns and land use to a more viable long-term enterprise.

In setting monetary policies for the economy, policies for government lending agencies, and regulating financial institutions, consideration should be given to the greater financial requirements of agriculture in the future, the financial needs of beginning farm operators, the financing of expansion of the farm unit when needed to improve efficiency, and the need for some farms and regions to finance adjustments to a less intensive land use.

In the more highly specialized, larger farm firm of the future the rewards for success and the penalty for failure will be much greater than in the past. Thus, lending policy for the larger loans that will be needed must rely more heavily on the qualifications of the operator and his potential for business success -- and less on asset security.

Not all farmers can or should achieve complete ownership.

Detailed study should be undertaken of the possibilities of adaptations of existing credit institutions or

creating new ones to (1) channel financial market loans to individual farmers for a long term on the principle of a corporate bond or (2) provide farm operators with adequate capital resources to initiate or expand operations, perhaps on the principal of the convertible debenture.

Agriculture tends to handle variable income flow through the lenders liquidity, often without prior arrangement, instead of through its own liquidity. A flexible repayment schedule which would still amortize the loan during the agreed payback period would help farmers cope with seasonal incomes."106/

An industry can measure its overall credit position by:

1. Overall production efficiency of industry -- if credit starved, it would be inefficient. American agriculture is not inefficient in production compared to the rest of the world.

2. The rate of return on farm production assets is another measure. If starved for credit, the rate would be high. If credit were scarce, then assets would be cheap. They are relatively low -- 5% or less. There are 61 major industries receiving over 5% on investment listed on the American Stock Exchange in 1969.

3. Interest paid by farmers is higher than some other businesses, but their terms and loan size make it difficult to compare. Farming seems to be in a more favorable position with respect to interest rates than 20 years ago.107/

"Probably, farmers do have relatively good access to money markets, and money is available to those who can benefit from it."108/ In the future agriculture will have to continue to be resourceful and be a strong competitor for money.

106/ Loc. cit., Food & Fiber, p. 238 and 242.

107/ Loc. cit., Francis, p. 5 - 6.

108/ Loc. cit., Problems and Issues In Financing Today's Agriculture, Brake, p. 3.

"Predicting earnings and rates of interest are important in using more capital and borrowing to acquire farm resources. The Director of Research of the Farm Credit Administration expects the competition for capital to remain intense among the sectors of the economy during the 1970's. The supply of funds is expected to be adequate but demand pressures will keep interest rates from falling greatly. Capital will continue to be substituted for labor in agriculture, prices of inputs will continue to increase, farms will increase in size and efficiency, and aversion to debt and other arrangements to bring resources together will be less. This means that future demand for capital in agriculture is expected to increase."109/

"Long run profit prospects from irrigated crop production are basically considered to be good for the man who does a good job with crops which are well adapted to his locality and, specifically, to his soil types. But the capital outlay necessary to secure these returns is high. Some farmers find it necessary to borrow a high proportion of the capital required for this new development. This usually results in steep annual payments to service the debt incurred. As a result, an extremely low standard of living must be accepted for a time, or the business may even fail. Adequate study of the capital requirements and selection of methods of financing and repayment which are feasible, are important to the success of the venture. Certainly, the operator must survive (financially)in the short run, if he is to be there to enjoy the profits in the long run."110/

109/ Wilfred H. Pine, Future Demand For Farm Capital, Extension Economics, Kansas Farm Business Information, Cooperative Extension Service, Kansas State University, Manhattan, Kansas, January 20, 1971, p. 2.

110/ Loc. cit., Economics of Irrigation, Thomas, p. 1.

CHAPTER VIII

SUMMARY

Irrigation is one alternative that farmers in South-Central Kansas have to expand the economic size of their business. This paper has attempted to exhibit how this increased economic activity may increase the irrigation farmer's net farm income.

The estimated costs and returns for well water supplied irrigated crops usually grown in the area were reviewed by the use of actual farm records of a representative group of Farm Management Association members for 1968 and 1969. Specific examples of cost and return data for flood and center-pivot sprinklers were reviewed through the use of case study farms using these two common water application methods.

This information was compared with other data available from similar irrigation areas in Kansas, Oklahoma, Nebraska, and South Dakota. This illustrated that South-Central Kansas farmers were generally competitive in their use of irrigation as an alternative. Because of the usual expected increase in natural rainfall, farmers could expect less increase in crop production due to irrigation than could the more arid western areas of Kansas. Average lower development and pumping costs due to shallower wells in South-Central Kansas compared to Western Kansas did tend to offset the lower expected production increase between the two areas.

The case study farms were used to illustrate the expected development costs of surface flood and center-pivot sprinkler irrigation. The case study farms were used to exhibit various cash flow patterns

that may develop because the farmer made the decision to adopt irrigation as a part of his farming technology. The cash flow illustrations, balance sheets, and production analysis figures available for the case study farms were used to show what useful techniques could be used by a farm manager to pre-analyze an irrigation development project.

It becomes evident that one of the major limiting factors for any future irrigation development in the South-Central Kansas area is capital. A rather brief exploration of possible available means of financing irrigation projects by individual farmers is undertaken. This area of study needs more research.

In general terms irrigation is a profitable alternative in South-Central Kansas where a well water supply exceeds 500 gallon per minute and the water is of good quality. The major limiting factor for future irrigation development in the area is available development and operating capital. Development capital seems to be the most limiting since intermediate capital seems to be less available than long term or short term capital in the South-Central Kansas area.

Before a specific farmer adopts irrigation on his farm he needs to analyze his own management abilities, review the possible profit potential, and survey the water, land, labor and capital resources available to him. Analysis techniques illustrated in this paper are highly useful and recommended for evaluation of expected cost and return and projected cash flow data on an individual farm. A farmer may need to seek professional assistance in applying this analysis.

APPENDIX

Table 81

LIST OF IRRIGATORS IN

11 COUNTY FARM MANAGEMENT ASSOCIATION

AREA STUDY 1968 - 1969

	HOURS PUMPED 1968	GPM 1968	ACRES 1968	ACRE INCHES PUMPED PER ACRE	HOURS PUMPED 1969	GPM 1969	ACRES 1969	ACRE INCHES PUMPED PER ACRE	DEPTH OF WELL AND WATER LEVEL
BARTON									
R.E.	1050	1000	152	15.26	530	1000	102	19.23	55' & 21'
B.L.	770	1100	80	23.38	---	----	---	-----	60' & 24'
R.O.	722	1100	106	19.40	167	1200	86	5.71	150' & 34'
E.S.	1403	1400	150	28.93	6798 (2 wells)	3000	280	16.09	84' & 19'
L.C.	1862	742	70	43.50	722	740	70	16.90	54' & 16'
B.E.	----	---	--	-----	1680 (2 wells)	2600	230	4.20	24' deep 110' deep
E.B.	----	---	--	-----	----	----	---	-----	----------
HARVEY									
D.C.	(124 Acre Feet Used)		54	27.55	----	----	---	-----	----------
E.S.	670	800	91	13.07	650	800	90	13.00	180' & 30'
R.R.	1110	1275	110	28.30	870	1240	110	21.58	79' & 27'

Table 81

	HOURS DUMPED 1968	GPM 1968	ACRES 1968	ACRE INCHES PUMPED PER ACRE	HOURS PUMPED 1969	GPM 1969	ACRES 1969	ACRE INCHES PUMPED PER ACRE	DEPTH OF WELL AND WATER LEVEL
MCPHERSON									
R.C.	1085 (2 wells)	1175	102	27.71	618	1250 (2 wells)	102	16.78	65' & 30'
P.D.	----	1001	---	-----	---	----	---	-----	69'
M.S.	1150	1200	142	21.56	1250	1200	140	23.80	99' & 42'
D.J.	563	1100	80	17.19	629	1000	80	17.43	140' & 42'
W.F.	178	1200	61	7.92	418	1100	---	-----	----------
L.S.	583	700	48	19.42	---	----	---	-----	River Pumping
W.W.	---	---	--	-----	---	----	---	-----	----------
P.K.	---	---	--	-----	783	----	73	-----	129'
RICE									
L.S.	2400	3800 (3 wells)	336	22.95	2520	3800 (3 wells)	333	18.46	
W.E.	1030	380	73	11.84	530	380	80	5.58	70' & 30'
R.M.	591	750	80	12.30	709	800	80	15.75	68' & 17'
M.R.	1285	1000	140	20.39	925	1100	140	16.14	80' & 18'

Table 81

	HOURS PUMPED 1968	GPM 1968	ACRES 1968	ACRE INCHES PUMPED PER ACRE	HOURS PUMPED 1969	GPM 1969	ACRES 1969	ACRE INCHES PUMPED PER ACRE	DEPTH OF WELL AND WATER LEVEL
STAFFORD									
W.M.	----	----	---	-----	292	1290	88	9.8	100' & 24'
R.N.	1150	800	80	25.55	750	800	115	11.53	84' & 28'
RENO									
B.C.	----	---	---	-----	---	----	---	-----	----------
M.M.	----	---	---	-----	---	----	---	-----	----------
SEDWICK									
B.H.	563	2200 (2 wells)	100	29.47	560	2200 (2 wells)	100	29.33	47' & 10'
F.B.	890	1500	96	31.04	---	----	---	-----	50'
Q.B.	1110	1500	159	23.12	1100	1200	160	18.33	111' & 20'
D.L.	1606	480	80	21.41	----	1000	92	-----	55' & 23'
AVERAGE		908		22.43"		1059		15.35"	84' well d. 19' water l.
RANGE		283-1600		8"-43"		380-1290		4"-29"	24' - 180' well depth 25.9' water level

Table 82

NON-REAL ESTATE LOANS TO FARMERS: OUTSTANDING AMOUNTS REPORTED BY PRINCIPAL LENDING INSTITUTIONS, UNITED STATES, SPECIFIED DATES, 1915 to 1970 1/

Beginning of year or month	All Operating Banks	Agencies Supervised By Farm Credit Administration			Farmers Home Administration				Total, excluding loans guaranteed by Commodity Credit Corporation
	Excluding loans guaranteed by Commodity Credit Corporation	Excluding loans guaranteed by Commodity Credit Corporation	Including loans guaranteed by Commodity Credit Corporation	Federal intermediate credit banks 2/	Operating loans 3/	Emergency loans 4/	Emergency crop and feed loans 5/	Total	
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1915	1,605,958	-------	-------	-------	-------	-------	-------	-------	1,605,958
1920	3,453,794	-------	-------	-------	-------	-------	-------	-------	8/3,455,253
1925	2,674,237	-------	-------	-------	-------	-------	2,513	2,513	8/2,713,162
1930	2,490,742	-------	-------	-------	-------	-------	7,976	7,976	8/2,546,104
1935	627,878	60,459	60,459	55,083	5,600	87,087	111,238	203,925	947,345
1940	900,079	153,425	153,425	32,316	242,200	8,005	167,795	418,000	1,503,820
1945	948,829	188,306	203,794	9/29,966	300,908	13,618	138,068	452,594	1,619,521
1946	1,033,800	194,788	201,135	26,487	276,945	7,388	128,901	413,234	1,668,309
1947	1,289,105	230,025	238,321	31,701	279,727	3,695	116,733	400,155	1,950,986
1948	1,592,762	289,077	292,560	37,916	262,021	2,634	105,913	370,568	2,290,323
1949	1,945,598	366,822	367,699	55,750	249,077	3,073	90,048	342,198	2,710,368
1950	2,048,819	387,454	387,547	50,825	262,714	12,771	71,186	346,671	2,833,769
1951	2,524,153	450,673	450,710	62,073	253,538	22,544	53,283	329,365	3,366,264
1952	3,120,196	561,371	561,445	77,841	245,754	20,110	38,191	304,055	4,063,463
1953	3,195,058	599,295	599,364	82,931	281,054	28,739	27,919	337,712	4,214,996
1954	2,762,562	541,786	541,793	63,557	304,900	50,792	19,946	375,638	3,743,543
1955	2,933,851	576,997	595,789	58,276	330,345	70,532	16,327	417,204	3,986,328
1956	3,308,443	644,449	645,959	61,907	319,443	72,747	13,494	405,684	4,420,483
1957	3,279,911	699,283	699,670	60,007	337,832	81,776	11,079	430,687	4,469,888

Table 82 (Cont.)

Beginning of year or month	All Operating Banks: Excluding loans guaranteed by Commodity Credit Corporation	Agencies Supervised By Farm Credit Administration: Excluding loans guaranteed by Commodity Credit Corporation	Agencies Supervised By Farm Credit Administration: Including loans guaranteed by Commodity Credit Corporation	Agencies Supervised By Farm Credit Administration: Federal intermediate credit banks 2/	Farmers Home Administration: Operating loans 3/	Farmers Home Administration: Emergency loans 4/	Farmers Home Administration: Emergency crop and feed loans 5/	Farmers Home Administration: Total	Total, excluding loans guaranteed by Commodity Credit Corporation
1958	3,605,183	885,918	885,928	67,192	348,181	79,203	8,306	435,690	4,993,983
1959	4,160,660	1,114,694	1,114,731	83,722	339,702	60,071	5,852	405,625	5,764,701
1960	4,819,340	1,361,198	1,361,212	89,576	346,526	47,031	4,028	397,585	6,667,699
1961	4,991,473	1,479,805	1,479,805	88,446	377,504	39,031	2,977	419,512	6,979,236
1962	5,315,852	1,640,219	1,640,219	98,784	447,603	46,097	2,381	496,081	7,550,936
1963	5,979,484	1,838,977	1,838,977	109,667	500,905	53,155	2,133	556,193	8,484,321
1964	6,652,171	2,105,490	2,105,490	125,681	539,256	52,695	1,830	593,781	9,477,123
1965									
Jan.	6,990,021	2,277,510	2,277,510	124,707	586,253	56,083	1,577	643,913	10,036,151
July	7,660,348	2,726,821	2,726,821	138,480	723,496	104,550	1,500	829,546	11,355,195
1966									
Jan.	7,676,853	2,578,929	2,578,929	139,520	651,335	64,277	1,408	717,020	11,112,322
July	8,490,178	3,121,806	3,121,806	165,170	734,089	120,394	1,322	855,805	12,632,959
1967									
Jan.	8,533,489	3,015,639	3,015,639	156,930	665,827	70,516	1,115	737,458	12,443,516
July	9,334,871	3,622,795	3,622,795	181,859	779,022	124,275	900	904,197	14,043,722
1968									
Jan.	9,271,660	3,517,902	3,517,902	176,415	720,591	76,700	753	798,044	13,764,021
July	9,980,678	4,065,235	4,065,235	201,684	798,279	139,103	615	937,997	15,185,594
1969									
Jan.	9,719,738	3,825,821	3,825,821	180,181	731,315	89,877	489	821,681	14,547,421
July	10,553,634	4,535,035	4,535,035	219,108	790,102	148,319	415	938,836	16,246,613
1970									
Jan.	10,329,766	4,494,821	4,494,821	217,838	714,783	70,003	323	785,109	15,827,534

Table 82 (Cont.)

1/ Data for 48 States through 1959; thereafter, Alaska and Hawaii are included. Some loans have real estate security but all are short or intermediate-term. In their fundamental characteristics and uses, these loans differ greatly from most of the farm-mortgage loans reported in earlier tables.

2/ Loans to and discounts for livestock loan companies and agricultural credit corporations.

3/ Includes production and subsistence, rural-rehabilitation, construction, economic opportunity, and wartime-adjustment loans and similar loans made from State Corporation trust funds (except for Jan. 1, 1938 through Jan. 1, 1942).

4/ Includes production emergency, economic emergency, special emergency, and special livestock flood-damage, fur, orchard, and flood and windstorm-restoration loans, and loans made by the regional agricultural credit corporations before their dissolution in 1949.

5/ Includes seed, feed, crop-production, drought-relief, and orchard-rehabilitation loans.

Table 83

AMOUNTS OF VARIOUS AGRICULTURAL PRODUCTS REQUIRED TO PAY $1,000 OF DEBT, U.S., SELECTED YEARS 1920 - 1965

YEAR	200 LB. HOGS	1000 LB. CATTLE	BUSHELS WHEAT	BUSHELS CORN
1920	39	10	463	1,852
1930	57	13	1,508	1,818
1940	93	13	1,484	1,664
1945	36	8	671	813
1946	29	7	516	654
1947	21	5	437	463
1948	22	5	505	781
1949	28	5	532	806
1950	28	4	500	658
1951	25	3	474	602
1952	28	4	478	658
1953	23	6	490	676
1954	23	6	472	699
1955	33	6	503	741
1956	35	7	508	775
1957	28	6	518	901
1958	26	5	571	893
1959	35	4	568	962
1960	33	5	571	1,004
1961	30	5	546	926
1962	31	5	490	909
1963	34	5	541	917
1964	34	6	730	870
1965(3)	24	5	752	917

U.S. Average prices received by farmers, weighted crop year averages for crops and weighted calendar year averages for livestock items.

(1) Equivalent on-tree returns for all methods of sale.

(2) Beginning 1935 apples for fresh consumption.

(3) Preliminary.

SOURCE: Economic Research Service, U.S.D.A.

PCA's Intermediate-Term Loan Policies

The following is a guideline policy recommendation by the Federal Intermediate Credit Bank in Wichita to the local PCA's in making Intermediate-Term or 'IT' loans:

Intermediate-Term Loans

A. Maturities. Maturities may not exceed 40 months (3 years and 4 months) on loans for equipment purchased for $6,000 or less, nor over 5 years on loans for machinery and equipment purchased for more than $6,000, including irrigation equipment and dairy installations and buildings not considered as permanent structures affixed to the land.

B. Margins - Collateral.

1. On new equipment (except dairy) at least one-third down payment, based on actual cost rather than list prices, is required. On used equipment, at least one-third down payment, based on value, is required.
2. On dairy equipment (such as bulk milk tanks and pipeline milkers) up to 85 percent of the actual cost to the operator can be loaned if installments are made on a monthly basis. If installments are made on an annual basis, one-third down payment of the cost will be required.
3. On real estate loans, the loan should not exceed 65 percent of the normal agricultural value of the collateral or 50 percent of the current market value.

If it is practical and desirable to make a loan exceeding 50 percent of current market value because of unusual repayment potential from outside income, the loan must have prior approval of the Bank. Value is to be determined by a competent appraiser. Where land purchase or financing is involved, a written statement from the manager of the Federal Land Bank Association is required, stating his concurrence that the needs of the member can best be served through intermediate-term financing. Only first mortgages or trust deeds can be taken.

4. Caution should be exercised in financing machinery, taking into account such factors as the rate of depreciation, obsolescence, and the date of possible replacement. This is extremely important in financing used machinery and will vary from loan to loan and credit factors must be observed.

C. New - Renewals - Advances - Extensions. It is permissible for each member to have more than one intermediate-term loan. Discretion should be exercised when more than one intermediate-term loan is approved. In such cases, credit factors will control.

1. Renewals - No renewals past the original maturity date may be made. If an intermediate-term loan is renewed when original equipment is traded, a new schedule of repayments can be set up for the period. If a loan is renewed when additional equipment is purchased, the schedule of repayments remaining on the previous loan

must be maintained and the installments covering the additional purchases should be added to the installments of the original contract.

2. Additional advances are permissible if the scheduled installments on the additional advance have the same payment date as the dates of the remaining installments due on the original loan.
3. Where additional equipment is purchased which cannot conveniently be financed under (1) & (2) above, another intermediate-term loan can be made.
4. An intermediate-term loan interest agreement (PCA Form 444) should be executed on each intermediate-term loan.
5. Extensions, if considered, may be made on final installments only.

D. Forms to Accompany 'IT' Loans.

1. Regular applications completed as to financial statement, loan purpose, and repayment schedule. (More complete when a member does not have a current operating loan.) Total value of collateral should be shown.
2. An inspection or a realistic determination of values will be required on machinery and equipment refinanced.
3. Financing statement, chattel abstract, security agreement, installment note if member has a financing statement covering the class of collateral which might have been taken on another loan, a statement to that effect should be made.

The Garden City, Kansas PCA, usually ranking first to third nationally in total loan volume has been recognized as a leader in irrigation financing. They were called upon to furnish a set of guidelines for other PCA's when requests for center pivot sprinkler loans were made. A copy of these guidelines states:

"Subject: Sprinkler Financing and Related Considerations.

1. Finance Term: Probably five to seven years as an intermediate term of less time puts to much re-payment pressure on the average cash flow. Some farmers secure long-term insurance company loans at from $30,000 to $40,000 per quarter-section depending on the appraised land value prior to development. This type loan secures land, well, engine, and sprinkler generally for a twenty year term.

2. Down Payment: Generally a minimum of 20% and more probably nearer 30% seems to be more prevalent. Some of the sprinkler manufacturers are attempting to secure a sales promotion technique rather than looking at it from a financing stand-point. It should be considered that in the 'tight money' era that most buyers will probably have to borrow the down payment somewhere regardless of the percentage required.

3. Equipment Life: The Internal Revenue Service has suggested a ten-year depreciable life. There are many sprinklers which have been well maintained that are older than ten years. It is difficult to place a realistic life on a sprinkler as every part is easily replaced including pipe and towers, but ten years is probably average. The amount of maintenance cost that a farmer can afford or decides necessary is an important consideration here. The brand of sprinkler is also a consideration since some are painted and some are galvanized which is suppose to prolong the equipment life.

4. Repossession: There has been one (1) repossession of a Valley Sprinkler in the 27 county territory, I was associated with. This sprinkler should never have been sold in the first place since the farmer did not have the necessary financial condition to make such an investment.

5. Salvage Value: Approximately $2,000 at the end of ten years. Market value at the end of seven years seems to be between $5,800 and $7,000. This is based on three or four Valley Sprinklers sold during the Spring of 1970 and were purchased originally in 1963 and 1964.

6. Repayment History: There have been many instances of time extension requests on payments. Generally this extension period is 60-90 days and involves loans carrying interest rates of 12-14%. It should also be considered that possibly this type of customer should have waited a year or so until he was in a bit more solid financial condition to handle such a commitment. It is also possible that poor crops or a down cattle market cause such requests, but I feel that over-extension is the usual reason.

7. Sprinkler Makes: Equipment life, maintenance costs, dependability, available service for the equipment, manufacturing engineering, etc., are all to be considered by the farmer and the lending institution in determining what brand of sprinkler to buy. Retail price must also be considered carefully to include just what the farmer is buying regarding dealer service reputation, reputation of the brand he is considering, and reputation of the manufacturer. Simplicity of engineering and propulsion should be considered as the farmer generally is not too well schooled to handle intricate problems of some complicated and poorly engineered pieces of equipment. Certainly, with the amount of investment dollars we are talking about, he should not have to worry too much about whether or not the sprinkler is running as it should be. For what it is worth, I have rated in order the following sprinklers which I have been exposed to -- please bear in mind that I would lean toward Valley:

    1. Valley -- water hydraulic drive, galvanized.
    2. Olson -- oil hydraulic drive, partially galvanized.
    3. Gifford-Hill 360 -- electric drive, painted.
    4. Hygromatic -- water & gear box drive, painted.
    5. Shaffer -- oil hydraulic drive, painted.

    There are many other makes of sprinklers, but these seem to be the leaders in this area.

8. Customer Identification: I feel this is a most important and probably overlooked factor from a sales organization stand-point. A farmer's ability to make a profit with the use of a sprinkler is the only real consideration of importance. Sprinkler irrigation and farming technique is very

different from dryland or flood irrigation. The farmer's history, management ability, working capital situation and farming program must be considered as just every farmer or rancher is not a potential sprinkler owner. I fear too many dealer organizations are presently involved in 'pressure sales' and big advertising programs to sustain and promote sales. As sales oriented people say "there is a buyer for anything if proper sales techniques are used". The farmer must be told and he must understand and have the available borrowing and repayment power to handle increased production cost for sprinkler irrigated farming.

9. Summary: There is certainly a place and need for sprinkler irrigation, but I feel that a careful consideration for financing these projects is most important. There are many lending institutions which I fear have not taken a 'hard' enough look at specific customers and what a situation he might be getting into. This irrigated pasture program appears to be adding flexibility in the usuage of sprinklers and may encourage more people in agriculture to add flexibility in their farming and ranching programs which I think is very important in our present day economics. Considering the fact that $100 per acre land plus a sprinkler installation shows a capital investment of over $40,000 per quarter-section, the farmer must operate from a realistic cash flow and constantly bear in mind that without the sprinkler he has 160 acres of rolling land with a well on it that will not flood irrigate."[11]

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[11] Sprinkler Financing and Related Consideration, a letter obtained in an interview with Mr. Leonard Deetz, Federal Intermediate Credit Bank, Wichita, Kansas -- written by a representative of the Garden City, Kansas PCA.

CREDIT POLICY

The following Credit Policy was adopted by the Board of Directors of the Manhattan Production Credit Association on OCT 29 1970.

1. GENERAL LOAN POLICY

This association was established to provide short and intermediate-term credit for all types of farm and ranch operations for the farm people of this area. It is recognized that the usefulness and permanency of this association depends primarily upon the extension of an improved credit service to agriculture on a sound and constructive basis, efficient operation at a cost consistent with good business methods, and prompt and convenient service to the qualified farmer.

To be a permanent and dependable source of credit, the association must constantly give careful consideration to those factors which contribute to sound lending and endevor to actually finance the operation and not merely make a loan and become another creditor. The five credit factors: man, financial condition and progress, repayment capacity, loan purpose, and collateral, should be considered on all loans, with emphasis on the man factor and profitability of the unit.

In order to carry out a program that is sound for the farmer, with prompt, courteous service always in mind, it is the intention of the board to delegate maximum responsibility and authority to association personnel so that they can carry on their day to day duties in an efficient and business-like manner.

2. PREREQUISITES FOR LOANS

Loans will be extended to all eligible applicants who have a sound basis for credit, regardless of the type of farming.

Sufficient investigation should be made of all new applicants to determine more a responsibility, managerial ability of the applicant and the profitability of the enterprise.

New applicants should have sufficient financial strength and equity in their operation so that the association can continue to finance the operation through adverse periods. A strong backlog of financial strength is particularly necessary where high risk operations are being financed.

Field reports should be prepared on all new applicants prior to disbursement.

Loan applications should be complete on all new loans so that proper credit analysis can be made.

If debt refinancing is part of the loan purpose, a history of the debt should be obtained from dependable sources.

Amount and loan purpose shall be in line with the applicant's ability to repay and shall cover necessities, needs and wants in this order of priority.

Repayment programs shall be prepared on a conservative and realistic basis, with full recognition to the applicant's past performance. Full consideration must be given to the factors which influence production and income.

Collateral requirements will be determined by the strength of the

credit factors. Adequate primary and secondary collateral will be required to protect the association during the life of the loan. Generally primary collateral shall consist of the assets providing the income from which repayment is expected.

3. OPERATION CREDIT

All operating credit should be repaid on an orderly basis from the income of the enterprise being financed.

Care should be taken in preparing the cash flow projections for the unit. Repayment abilities should be based on realistic and accurate information, making use of past production records, as well as future adjustments in the operation, and anticipated prices to be received.

As a general rule, operating loans should be secured by the products being produced plus a reasonable margin of secondary security.

4. INTERMEDIATE TERM CREDIT

When the credit factors justify, loans may be made for eligible capital purposes or for the refinancing of current debts originally created for such capital purposes, with maturities up to 5 years.

The longer the maturities, the stronger the credit factors should be. Repayment capacity should be adequate to repay annually the operating cost and recurring expenses and provide a margin of profit which can orderly repay the capital credit extended on intermediate terms.

Length of maturity will be determined by age of the borrower, continuity of operation, type of capital item, collateral, and the over-all quality of the farm operation.

On all intermediate term loans, the constructiveness of the purpose of the credit extended, particularly as to the effect on the repayment capacity of the operation, should be of prime consideration. Major split lines of credit should be avoided.

Security requirement on intermediate term loans should be consistent with the strength of the credit factors and should be adequate throughout the term of the loan, taking into account such factors as the rate of depreciation, obsolescence, and date of possible replacement. Insurance coverage, with the loss payable clause in favor of the association, should be required on all IT loans, where the member does not have the ability to withstand a major loss.

5. UNSECURED LOANS

Unsecured loans may be made to members where all credit factors are strong. As a general policy unsecured loans will be limited to short term credit and not in excess of 15% of the operator's Net Worth administrated as a line of credit not as an accountability of security. As a general policy wives should co-sign all unsecured notes or credit life insurance coverage should be required.

6. ADDITIONAL ADVANCES

It shall be the policy to make budgeted loans providing complete financing for a reasonable lenght of time. When the entire credit needs for the term of the loan cannot be set up in the original application, additional advances may be made. The additional advances, to the extent credit factors

warrant, should include budgeted credit needs.

7. SUPERVISION

Desirable credit relations are based on mutual confidence and complete understanding between the member and the association. Credit can be extended constructively and soundly only in the light of complete and reliable facts regarding the applicant and his business. The association's personnel, under the direction of the managing officer, should carry out a program of proper loan supervision, so that the best interest of the member will be served. This program should include, but is not limited to these activities:

A. Field contacts should be made on all loans - vary from casual to the complete reappraisls depending on the conditions surrounding the loan.

B. More frequent field contacts will be made on loans to new members and on problem type loans.

C. Adjustment and acceleration of disbursement schedules will be determined by conditions and justification of such request within limitations of authorities granted.

D. The association will follow a firm collection policy with proper controls to insure that repayment plans are followed. Willful and repeated diversion of proceeds will not be tolerated.

E. On a carry-over, resulting from conditions beyond the member's control, every effort should be made to help the member work out of his financial difficulties, however, if additional credit does not constitute sound lending, it should be extended only when it will aid in working out the carry-over.

F. All loan files should be kept complete and all pertinent credit information should be written out and filed.

FIELD RECORD SHEET

Crop Year_____ Crop Grown_____

Landlord_____ Legal Description_____

Total Acres_____ Crop Acres_____

ASCS Allotments: Wheat_____ Payments: Wheat_____
Feed Grain_____ Feed Grain_____
Conserving_____ Other_____
Diversion_____

Fertilizer used for crop_____

_____

Topography_____

Conservation Practices_____

Soil Type_____

Last Soil Test: P_2O_5_____
Organic Matter_____
K_2O_____
Ph_____
Other_____

Est. Value Per Acre_____

Irrigated --OR-- Dryland Acres

_____ _____ _____

Rainfall since last crop_____

Last five years crops on land_____ _____ _____ _____ _____

CHEMICALS USED

DATE	AMOUNT	NAME

PROBLEMS IN FARMING

IRRIGATION AND CULTIVATION PRACTICES SINCE LAST CROP

DATE	HOURS OF WORK	INCHES OF WATER (If Irrigated)	PRACTICE (Tool Used)	EVALUATION

QUESTIONNAIRE FOR IRRIGATION FARMER NAME_____

YEAR_____

1. Estimate % hired labor time spend on irrigation_____%
2. Average cost of nitrogen $_____, P_2O_5 $_____ K $_____

   Others $_____ per pound of actual.
3. Estimate % of seed and crop expense for irrigation_____%
4. Estimate % of utilities and dues and fees to irrigation crops_____%
5. Crop Insurance and hail insurance on irrigated crops $_____
6. Total pumping fuel cost $_____
7. Estimate % time crop machinery used on irrigated land _____%
8. Total cost of hired machinery help on irrigated land $_____
9. Amount and kind of home raised seed used on dryland_____ irrigated_____
10. Compare the number of operations you used on dryland and irrigated on the following: (How many on each?)

WHEAT	DRYLAND	IRRIGATED
Harrow		
Plow		
Chisel		
Sweep		
Disc		
Other		

MILO & CORN FOR GRAIN or SILAGE or SOYBEANS		
Chop Stalks		
Plow		
Disc		
Harrow		
Chisel		
Sweep		
Other		

11. Times watered this year and amount:

	TIME	INCHES
Wheat		
Corn		
Milo		
Soybeans		
Alfalfa		

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Capital Needs and Requirements For Irrigation in South-Central Kansas

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ABSTRACT

Irrigation is one alternative that farmers in South-Central Kansas have to expand the economic size of their business. This paper has attempted to exhibit how this increased economic activity may increase the irrigation farmers's net farm income.

The estimated costs and returns for well water supplied irrigated crops usually grown in the area were reviewed by the use of actual farm records of a representative group of Farm Management Association members for 1968 and 1969. Specific examples of cost and return data for flood and center-pivot sprinklers were reviewed through the use of case study farms using these two common water application methods.

This information was compared with other data available from

similar irrigation areas in Kansas, Oklahoma, Nebraska and South Dakota. This illustrated that South-Central Kansas farmers were generally competitive in their use of irrigation as an alternative. Because of the usual expected increase in natural rainfall, farmers could expect less increase in crop production due to irrigation than could the more arid western areas of Kansas. Average lower development and pumping costs due to shallower wells in South-Central Kansas compared to Western Kansas did tend to offset the lower expected production increase between the two areas.

The case study farms were used to illustrate the expected development costs of surface flood and center-pivot sprinkler irrigation. The case study farms were used to exhibit various cash flow patterns that may develop because the farmer made the decision to adopt irrigation as a part of his farming technology. The cash flow illustrations, balance sheets, and production analysis figures available for the case study farms were used to show what useful techniques could be used by a farm manager to pre-analyze an irrigation development project.

It becomes evident that one of the major limiting factors for any future irrigation development in the South-Central Kansas area is capital. A rather brief exploration of possible available means of financing irrigation projects by individual farmers is undertaken. This area of study needs more research.

In general terms irrigation is a profitable alternative in South-Central Kansas where a well water supply exceeds 500 gallon per minute and the water is of good quality. The major limiting factor

for future irrigation development in the area is available development and operating capital. Development capital seems to be the most limiting since intermediate capital seems to be less available than long term or short term capital in the South-Central Kansas area.

Before a specific farmer adopts irrigation on his farm he needs to analyze his own management abilities, review the possible profit potential, and survey the water, land, labor and capital resources available to him. Analysis techniques illustrated in this paper are highly useful and recommended for evaluation of expected cost and return and projected cash flow data on an individual farm. A farmer may need to seek professional assistance in applying this analysis.