



CAPITAL INVESTMENTS AND DISCOUNTED CASH FLOWS

In January of each year, I travel to Spokane to meet with 100-150 managers and directors of agribusiness firms from throughout the Pacific Northwest. This mid-winter conference attempts to focus on current topics of interest to the industry. It also provides an educational setting within which more traditional topics are addressed. In that regard, for over 10 consecutive years I have been asked to enhance industry leaders' abilities to approach and evaluate capital investment projects.

The decade-long interest in this topic is more symptomatic of industry need than a reflection of the quality of the program I present. Like so many sectors of our economy, the agribusiness industry continues to struggle with an ever-rising level of capital intensity and an always-constrained source of investment funds and cash flow. Each year, as I begin my presentation, I ask the managers/directors present how their firms currently confront capital investment decisions. Each year, I am disappointed and/or shocked by the response. Firms that annually invest large sums of capital are following procedures set down before the 1950s. Firms which grade, size, package, store, and market fruit have invested millions of dollars in high-tech packing line equipment and modem storage facilities utilizing decision criteria which existed before World War II. At times, I will be referred to more contemporary analytical documents, which prefaced the investment decision only to discover that the analytical effort was undertaken by the firm's primary lender and was not used by the firm in its decision to initiate the capital investment.

Rather, the analysis was utilized only by the lender to support (or reject) its decision to finance the project.

A rigorous means for evaluating alternative capital investments was developed in the mid-1940s. By the mid-1950s, much of 'corporate America' had assimilated these new analytical tools and found useful applications for them. Our agribusiness industry (particularly smaller rural-based firms) is only now recognizing the value and applicability of such tools. Agribusiness managers will often acknowledge that they had some previous exposure to the tools in college or prior employment. Their failure to incorporate this analytical rigor into their current organization rests on convenient excuses -- the decisions simply don't require or warrant complex analysis, the directors to whom they report prefer to keep matters simple, or the current competitive environment affords an agribusiness firm too few capital investment alternatives from which to choose. Quite frankly, such responses are inappropriate and generally incorrect. My hope is that I can convince you, the reader, that long-utilized payback procedures are not only obsolete but often incorrect as a measure of an investment's appeal. Moreover, I hope to convince the agribusiness industry that the adoption of discounted cash flow procedures is long overdue and easily accomplished.

Project Evaluation Techniques

Consider for the moment that your agribusiness firm has just undertaken the preliminary steps that focus on evaluating alternative capital investments. Keep in mind that two basic questions are being asked. First, management must determine if the expenditure of funds in any capital

project makes sense to the firm. Second, management must determine which capital project, of those being considered, appears most attractive.

Three simple steps normally precede the search for answers to these two basic questions. First, you must estimate or gather data on the volume of sales, prices, costs of materials, operating expenses, transport costs, capital investment requirements, competitive features, rates of obsolescence (or depletion), and other economic and business characteristics of the projects being evaluated. Second, you must prepare basic estimates of annual income to be derived from the investment, life of the project, and capital investment required. Assuming that more than a single project is being considered, you must select a convenient format for comparative analysis. Finally, management must be prepared to exercise managerial judgment to determine if the anticipated returns are large enough to warrant the attendant risks. The manager must select that project which appears most attractive, given alternative opportunities for capital spending. In addition, the timing of the investment must be judged relative to other pending developments in the firm.

The capital investment decision model described in this paper focuses only on the second of the three steps noted above. The model provides an arithmetic means to deal with project incomes, project life, and return on investment. The model assumes the database is available and credible. The model does not relieve management of the need to exercise sound judgment.

Payback Vs. R.O.I.

The concept of investment payback has a long and deeply ingrained legacy in the agribusiness industry. The production livestock industry still references a feed-conversion rate that reflects an animal's ability to repay the costs of its feed. Farm equipment manufacturers still prepare

advertising and promotion which measures the "seasons of usage" after which the equipment pays for itself. While this concept is not totally lacking in merit, I propose that it be discarded in favor of a return on investment measure that more adequately meets our needs. Investment payback indicates how long it will take to recover the original capital outlay. It tells us nothing about the earning power of an investment. Remember, the true worth of an investment depends on how much income it will generate after the original capital outlay has been recovered (Return on Investment or R.O.I.). Generally speaking, payback is a reliable measure of the relative worth of alternative investments cost only when the income-producing life of all projects being evaluated is about the same.

To further illustrate the payback vs. R.O.I. discrepancy refers to Exhibit I. Three different capital investment projects are shown, each requiring an investment of \$125,000 and generating an annual income of \$25,000 for a portion of its useful life. Since the annual incomes are identical, each project has an equal payback period of 5 years. By this standard alone, each project would be equally attractive (or equally unattractive). However, based on R.O.I. estimates, the projects vary from 1296 for Project I with the shortest life to 2696 for Project III with the longest life. You might argue that where payback periods are equal you select the project with the longest life. Alternatively, if the economic lives are equal, you select the project with the shortest payback. Unfortunately, the agribusiness environment is more complex and management is generally looking at projects with differences in the payback period and the project life.

Shifting from payback to R.O.I. as the more appropriate capital investment decision method is only a partial solution. Management that chooses R.O.I. is left with three alternative R.O.I. procedures from which to select. Clearly, the manager is left

with yet another choice, one that assures some uniform basis of comparability. The preferred choice should be the discounted cash flow R.O.I.

The reasons to use this method are:

- (1) It provides the only "true" rate of return afforded by all types of capital investment projects. For example, the original investment method usually overstates the return while the average investment method usually understates the return (see Exhibit III). The discounted cash flow R.O.I. is a compromise and usually generates returns lying between the two extremes.
- (2) It produces measures of R.O.I. that are meaningful and well understood by those in the financial world. The resulting measure is comparable to the means used in quoting interest rates on borrowed funds, yields on bonds, and various measures of the cost of borrowing money.
- (3) It is the only measure of R.O.I. that makes allowances for the differences in the time at which investments generate their incomes. In essence, it can discriminate among investments with low initial income that gradually increases, vs. a high initial income that gradually declines, vs. a uniform income throughout the investment's useful life.

It is this latter characteristic which should prove most attractive to the agribusiness industry. Our industry is so diverse, and yet so specialized, that time sequenced irregularities in an investment's income become almost commonplace. A further attribute is that the system provides management with the option to "speculate about" or "experiment with" different cash flow sequences, thereby, generating answers to contingencies not afforded by the budgeted data.

An Example of Discounted Cash Flow R.O.I.

First, Exhibits IV and V contain an example of a capital investment that generates a uniform flow of annual incomes. In this example, the payback period is computed in the usual manner by dividing the average annual income (after taxes, before depreciation) into the original investment. Since the investment's useful life is 15 years, the 15-year row of a "cumulative" discount table is referenced. Moving horizontally across this row, you search for a value matching the payback period. The column in which the matched value is found denotes the appropriate discounted cash flow R.O.I. that is sometimes referred to as the internal rate of return. The values listed in the cumulative discount table are simply sums of the discount factors for the time periods and rates of return indicated. As shown, \$4.675 is the present value of \$1.00 received annually for 15 years discounted at a 2096 annual rate.

It should become clear that the discounted cash flow procedure involves little more than finding the discount rate (R.O.I.) that renders the present worth of the investment's anticipated flow of income equal to the value of the original investment. Simply stated, in this case the expected cash flow of \$20,000 per year for 15 years has a present worth of \$93,510, about equal to the value of the original investment when that cash flow is discounted at 2096.

Exhibit V provides a slightly different view of this same outcome. Here it can be said that the procedure described above computes the R.O.I. on the balance of the investment actually outstanding from time to time over the life of the project.

As shown in Exhibit V, some part of the annual income (\$20,000) must be set aside to return the original outlay over its useful life (Repayment of Investment column). Only the remainder represents the true earnings (Available for Earnings column).

In year 1, a 2096 R.O.I. on an Investment Outstanding of \$93,510 is \$18,702. Deducting this value from the \$20,000 year 1 incomes leaves \$1,298 as a form of repayment on the year 1 investment. Hence, by year 2, the investment outstanding is \$92,212 (\$93,510 - \$1,298) and the process is repeated again for year 2 entries. Note that the discounted cash flow procedure is precisely the same as that involved in a typical household mortgage where you make fixed monthly payments to cover changing amounts of principal and interest. It's also interesting to note that while the discounted cash flow R.O.I. yielded 2096, had we used the traditional return on original investment method, it would have yielded just 1596. Had we used the traditional return on average investment method, it would have yielded almost 3096 (assuming straight-line depreciation and zero salvage value in both cases).

Our example in Exhibits IV and V assumed a stable or uniform income throughout the investment's useful life. Now let's assume a rising annual income for 5 years, a 15-year period of stable income and a 5-year period of declining income over an investment's 25-year useful life. In this case, we would normally have to discount the income on a year-by-year basis. Instead, we can simplify the procedure by breaking the calculations into three parts; i.e., assume 5 years of income equal to 6096 of normal, followed by 20 years of normal income (ignoring the decline in income at the end of its useful life since it would only minimally affect the results). Since this illustrative example includes the purchase of land, it will be sold after 25 years at its original cost.

As shown in Exhibit VI, a process is used whereby trial and error searches for a R.O.I. that generates a present value just about equal to the original investment. In this, case a discounted cash flow R.O.I. of 1596 is computed.

Some agribusiness capital investments are characterized by high early annual incomes,

but declining incomes thereafter. This is particularly true where obsolescence and/or declining technological productivity affect the investment. Exhibit VII references an investment of this kind. In this case, the first year's income is high, followed by 4 years of more modest income, followed by 5 years of lower incomes. The trial-and-error process is repeated again and yields a discounted cash flow R.O.I. of 2296 that computes a present value of declining cash flows just about equal to the original investment of \$61,060.

As this overall process is concluded, management must finally establish some benchmark R.O.I.'s against which to compare their discounted cash flow R.O.I. results. In essence, management must subjectively assess the business risks, competitive pressures, market environment and other factors in establishing some minimum acceptable R.O.I. Capital investment projects yielding discounted cash flow R.O.I.'s below that minimum are dropped from further consideration. Those exceeding the minimums are comparatively analyzed. The benchmark minimums usually reflect: (1) the firm's cost of borrowing money, (2) the returns normally expected by stockholders in the industry, (3) those returns judged adequate to attract additional investors, and/or (4) returns sufficient to keep equity capital from exiting the firm.

Conclusion

Consider for a moment how your agribusiness firm approaches its capital investment decisions. If your sole means for capital investment analysis rests on the payback method, you may wish to re-evaluate your choice. Investment payback analysis is not only limited in its applicability, it is also inaccurate in many instances. Return on Investment (R.O.I.) is a more polished, more accurate, and more universally applicable tool. Of the three alternative R.O.I. measures, discounted cash flow R.O.I. is the agreed on choice of

most contemporary managers and modern businesses. When properly used, it can be a powerful management tool. It is easier to introduce and apply than is commonly supposed. It is an extremely effective device for analyzing investments yielding regular patterns of cash flow. Even in the case of irregular cash flows, simplification procedures allow for its effective use.

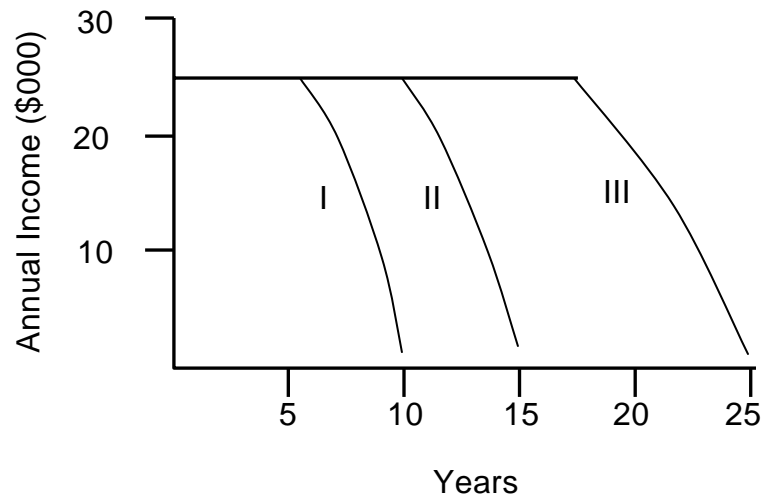
Our agribusiness industry is no longer operating in a 1950s environment and it can no longer afford to rely on capital

investment procedures in place at that time. I hope this paper will attract the interest of agribusiness managers and provide them with an educational base within which they can effectively use a discounted cash flow R.O.I.

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**EXHIBIT I
PAYBACK VS. R.O.I.**



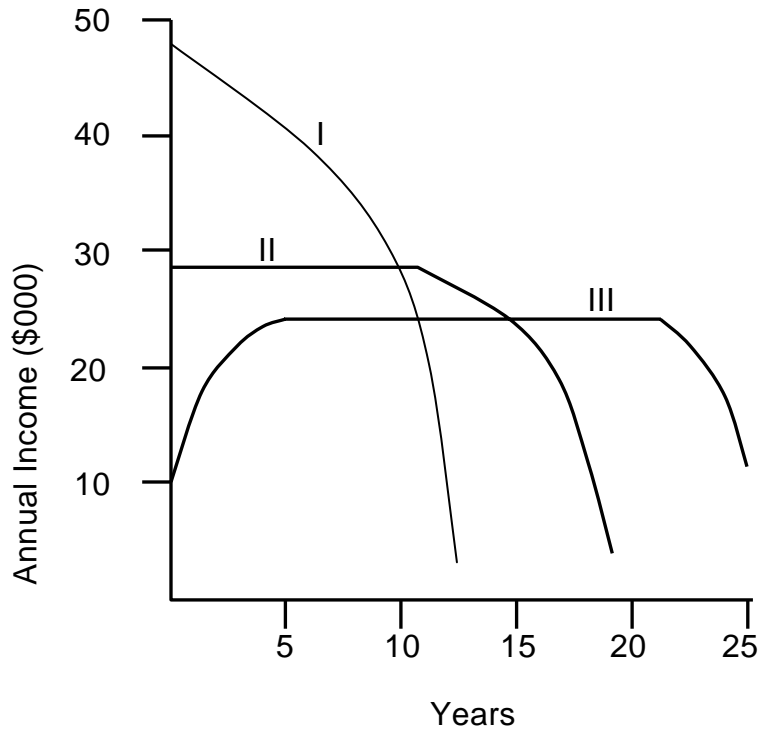
Project:	I	II	III
Original Investment	\$125,000	\$125,000	\$125,000
Life of Investment	10 years	15 years	25 years
Payback Period $\left[\frac{\$125,000}{25,000} \right]$	5 years	5 years	5 years
Return on Investment (after depreciation and taxes)	12% ¹	21% ²	26% ³

¹ Assumes 5 years annual income of \$25,000, followed by 5 years of annual income averaging \$15,000; straight-line depreciation for useful life of 10 years.

² Assumes 10 years annual income of \$15,000, followed by 5 years of annual income averaging \$15,000; straight-line depreciation for useful life of 15 years.

³ Assumes 15 years annual income of \$15,000, followed by 10 years of annual income averaging \$15,000; straight-line depreciation for useful life of 25 years.

**EXHIBIT II
PAYBACK VS. R.O.I.**



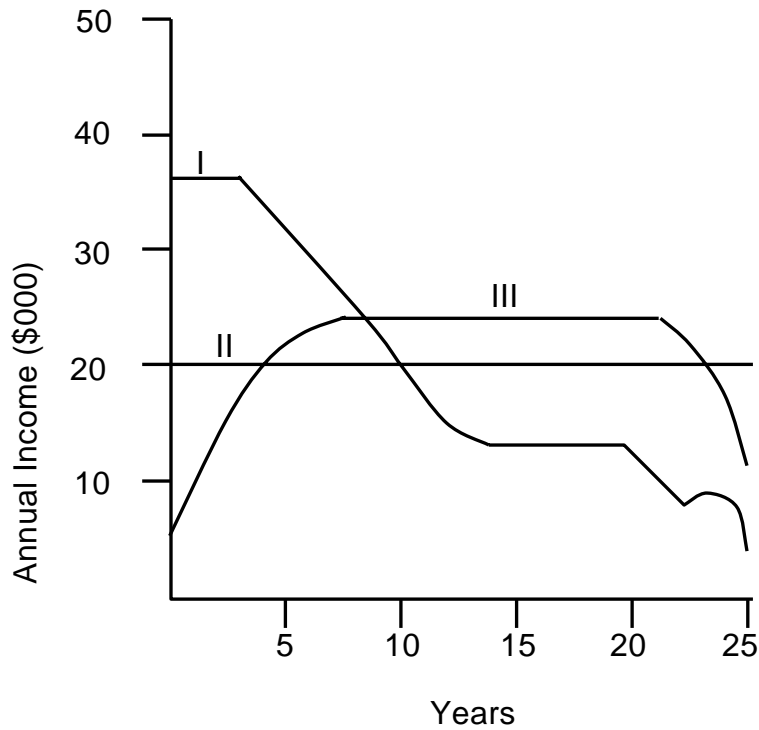
Project:	I	II	III
Original Investment	\$372,000	\$267,000	\$230,000
Life of Investment	13 years	18 years	25 years
Average Annual Income (before depreciation, after tax)	\$37,200	\$26,700	\$23,000
Payback Based on Average Income	10 years	10 years	10 years
Payback Based on Actual Income	8 years	8.7 years	11.5 years
Return on Investment (after depreciation and taxes)	4.6 ⁴	8.8% ⁵	12% ⁶

⁴ Deduct from average annual income each year's depreciation based on straight-line assumptions; divide the end-product by average annual investment.

⁵ Ibid.

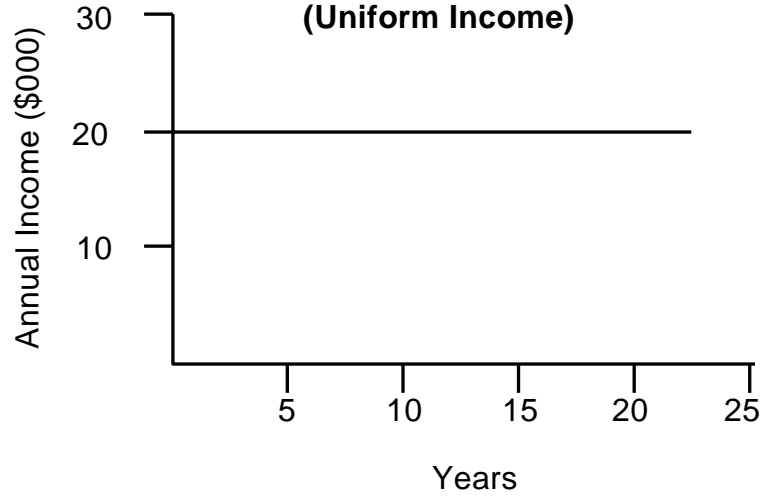
⁶ Ibid.

**EXHIBIT III
PAYBACK VS. R.O.I.**



Project:	I	II	III
Original Investment	\$125,000	\$125,000	\$125,000
Life of Investment	25 years	25 years	25 years
Total Income (after tax, before depreciation)	\$500,000	\$500,000	\$500,000
Average Annual Income (before depreciation, after tax)	\$20,000	\$20,000	\$20,000
Depreciation (\$125,000 ÷ 25 years)	<u>-5,000</u>	<u>-5,000</u>	<u>-5,000</u>
Average Annual Income (after taxes and depreciation)	\$15,000	\$15,000	\$15,000
Return on Original Investment $\frac{\$15,000}{125,000} =$	12%	12%	12%
Return on Average Investment $\frac{\$15,000}{62,500} =$	24%	24%	24%
Discounted Cash Flow R.O.I.	24%	15.50%	13%

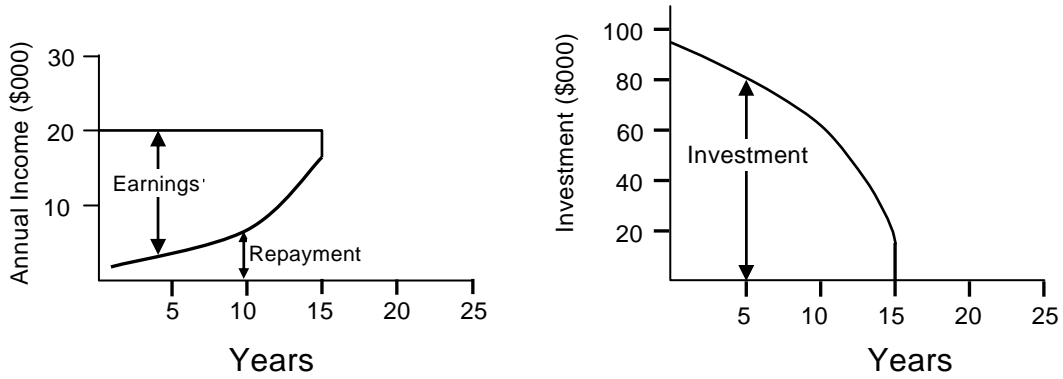
**EXHIBIT IV
DISCOUNTED CASH FLOW R.O.I.
(Uniform Income)**



Original Investment	\$93,000
Life of Project	15 years
Average Annual Income (after tax, before depreciation)	\$20,000
Payback Period $\frac{\$93,500}{20,000} =$	4.68 years
Disc. Cash Flow R.O.I.	20%

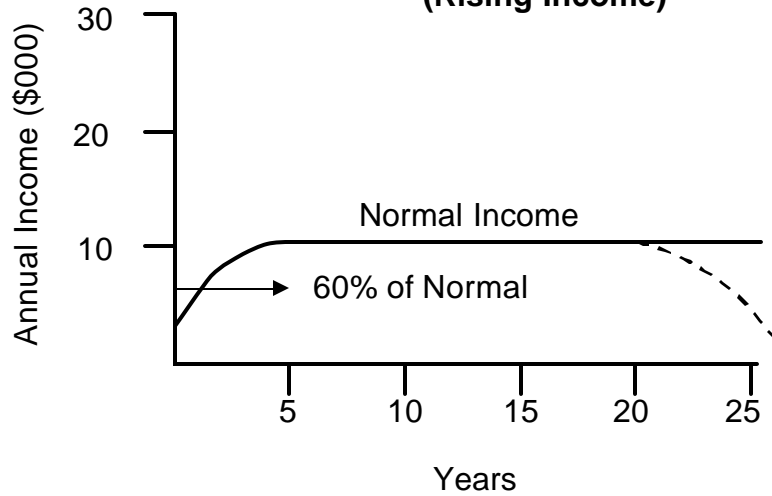
Discount Table – Present Value of an Annuity (Percentage R.O.I.)					
Project Life	18	19	20	21	22
1	0.847	0.840	0.8333	0.826	0.820
2	1.566	1.547	1.5278	1.509	1.492
3	2.174	2.140	2.1065	2.074	2.042
4	2.690	2.639	2.5887	2.540	2.494
5	3.127	3.058	2.9906	2.926	2.864
6	3.498	3.410	3.3255	3.245	3.167
7	3.812	3.706	3.6046	3.508	3.416
8	4.078	3.954	3.8372	3.726	3.619
9	4.301	4.163	4.0310	3.905	3.786
10	4.490	4.339	4.1925	4.066	3.923
11	4.650	4.487	4.3271	4.189	4.035
12	4.786	4.611	4.4392	4.290	4.127
13	4.901	4.715	4.5327	4.374	4.203
14	4.998	4.802	4.6106	4.444	4.265
15	5.081	4.876	4.6755	4.501	4.315
16			4.7296		
17			4.7746		
18			4.8122		
19			4.8435		
20			4.8696		

**EXHIBIT V
RETURNS SUMMARY – DISCOUNT CASH FLOW R.O.I.**



Year	Annual Income	Repayment of Investment	Available for Earnings	Investment Outstanding	R.O.I.
	\$	\$	\$	\$	%
1	20,000	1,298	18,702	93,510	20
2	20,000	1,558	18,442	92,212	20
3	20,000	1,869	18,131	90,654	20
4	20,000	2,243	17,757	88,785	20
5	20,000	2,692	17,308	86,542	20
6	20,000	3,230	16,770	83,850	20
7	20,000	3,876	16,124	80,620	20
8	20,000	4,651	15,349	76,744	20
9	20,000	5,581	14,419	72,093	20
10	20,000	6,698	13,302	66,512	20
11	20,000	8,037	11,963	59,814	20
12	20,000	9,645	10,355	51,777	20
13	20,000	11,574	8,426	42,132	20
14	20,000	13,888	6,112	30,558	20
15	20,000	16,670	3,330	16,670	20
	\$300,000	\$93,510	\$206,490	0	

**EXHIBIT VI
DISCOUNTED CASH FLOW R.O.I.
(Rising Income)**

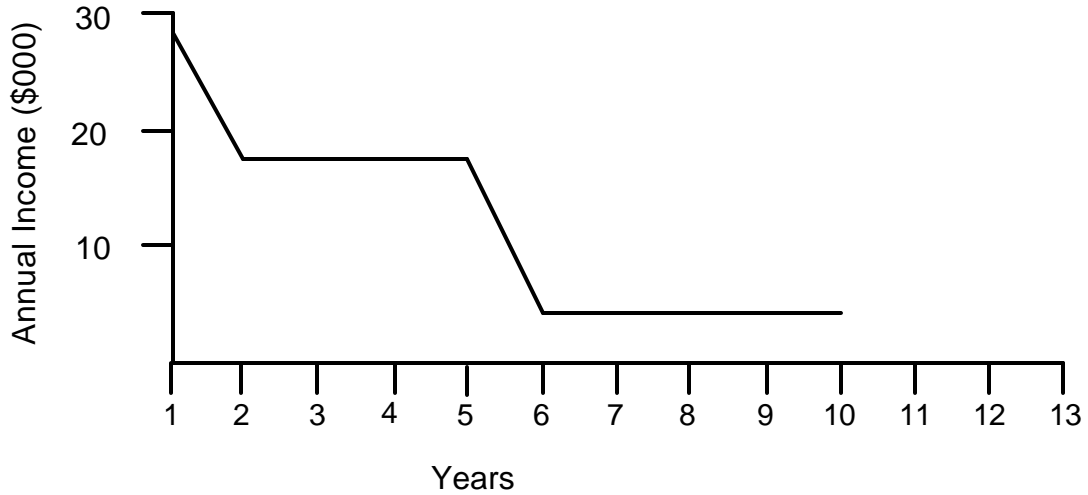


Cost of Plant/Equipment	\$27,000
Cost of Land	25,000
Total Original Investment	\$52,000
Normal Annual Income (after tax, before depreciation)	\$10,000
R.O.I.	15%

Year	Income	Discount Factor (15%)	Present Value
1-5 (60%)	\$6,000	3.352	\$20,112
6-25	10,000	3.112	31,112
Land 25 years	25,000	0.030	750
			Total \$51,974
Discount Factors			
Percent	1-5 Years	6-25 Years	Land Value -- 25 Years
11	3.696	4.726	0.074
12	3.602	4.238	0.059
13	3.517	3.813	0.047
14	3.433	3.440	0.038
15	3.352	3.112	0.030
16	3.274	2.823	0.024
17	3.199	2.567	0.020
18	3.127	2.325	0.016
19	3.058	2.138	0.013
20	2.991	1.957	0.010

PVA 5, 15%	PVA 25, 15%	PVA 25, 15%
3.352	- PVA 5, 15%	- PVA 24, 15%
	3.112	0.030

**EXHIBIT VII
DISCOUNTED CASH FLOW R.O.I.
(Declining Income)**



Equipment	\$36,430				
Materials	24,630				
Total	\$61,060	Original Investment			
		Year 1	Years 2-5	Years 6-10	Total Period Average
Annual Income (after taxes, before depreciation)		\$27,194	\$17,052	\$4,536	\$11,806
Discounted Cash Flow R.O.I. (22%) Discount Factor		0.82	2.04	1.06	
P.V.		\$22,290	+ \$34,854	+ \$4,806	= \$61,950
Discount Factors					
		Percentage			
Year	18	19	20	21	22
1	0.847	0.840	0.833	0.826	0.820
2	0.718	0.706	0.694	0.683	0.672
2-3	1.327	1.300	1.273	1.247	1.223
2-4	1.843	1.798	1.755	1.714	1.674
2-5	2.280	2.217	2.157	2.100	2.044
2-6	2.650	2.569	2.492	2.418	2.347
2-7	2.964	2.865	2.771	2.681	2.596
2-8	3.230	3.114	3.004	2.899	2.800
2-9	3.453	3.323	3.198	3.079	2.967
2-10	3.642	3.499	3.359	3.240	3.104
		3.104			
		-2.044			
		1.06			